UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ARIZONA ECOLOGICAL SERVICES STATE OFFICE
2321 W. Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951

Telephone: (602) 640-2720 FAX: (602) 640-2730

AESO/SE
2-21-94-F-243

June 16, 1997

John Bedell
U.S. Forest Service
P.O. Box 640
Springerville, Arizona 85938

Dear Mr. Bedell:

This biological opinion responds to your request of February 13, 1997, for formal consultation pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended, on normal and flood-related maintenance and repair of Forest Road (FR) 281 and connected, County-maintained roads along the upper Blue River on the Apache-Sitgreaves National Forests, Greenlee County, Arizona, using a set of Best Management Practices (BMPs), for an interim period of 12 months, during which initial steps will be taken to set in motion a process to find and implement a long-term solution to road effects. Additional section 7 consultation will be completed before the end of the 12-month interim period to address total effects of the existence, use, maintenance, and repair of the roads as modified by the long-term strategic planning process developed during the interim. This opinion also completes six emergency consultations of December 7, 1994, January 11, 1995, January 17, 1995, January 25, 1995, February 14, 1995, and March 10, 1995 on repair of flood damage to those roads. The Forest Service is lead agency on this consultation which covers actions of both the Forest Service and Corps of Engineers (COE). The species of concern in the formal consultation are the threatened loach minnow (Tiaroga cobitis) and bald eagle (Haliaeetus leucocephalus), and the endangered razorback sucker (Xyrauchen texanus), southwestern willow flycatcher (Empidonax traillii extimus), and American peregrine falcon (Falco peregrinus anatum). The consultation period began on February 14, 1997, the date your request was received in our office.

The Service supports the BMPs. The BMPs are an important step in protecting and restoring the aquatic and riparian ecosystem of the Blue River, and we commend the Forest Service and COE for their effort in developing them. The BMPs are an interim step in the overall effort needed. The environmental baseline of the ecosystem is degraded, and the roads in the upper Blue River are an important part of the problem. The Service believes the maintenance and repair of these roads, along with their continuing existence and use, when combined with the degraded state of the ecosystem, jeopardizes the continued existence of the loach minnow and adversely affects, but not to the point of jeopardy, the razorback sucker, southwestern willow flycatcher, bald eagle, and peregrine falcon. However, the temporal, accumulative nature of the road effects, the short time frame of this interim proposal, the inclusion in the proposed project

of initial steps in an effort to find and implement long-term solutions to road effects, and restrictions on work in the loach minnow spring spawning season are sufficient within the 12-month period to alleviate contribution to the jeopardy. At the end of the 12-month interim period, further action is needed to alleviate effects to loach minnow to remove the threat of jeopardy from the long-term effects of the road and its use, repair, and maintenance. The BMPs will alleviate some of the adverse effects and are important to minimizing damage while longer-term solutions are developed. The need for these long-term actions has been discussed throughout the four-year history of this consultation.

The following biological opinion is based on the information provided in the November 13, 1996, Biological Assessment and Evaluation (BA), the proposed Best Management Practices, telephone calls and correspondence of January-March 1995 regarding the emergency consultation, numerous telephone calls and faxes during the consultation period, numerous multi-agency site visits, data in our files, and other sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the species of concern or other subjects considered in this opinion. A complete administrative record of this consultation is on file in the Arizona Ecological Services Office in Phoenix.

Because of the length of this biological opinion, we have included the following table of contents to facilitate use:

TABLE OF CONTENTS

INFORMAL CONCURRENCES

The Forest Service determined that the proposed project is "not likely to adversely affect" the endangered razorback sucker and southwestern willow flycatcher , and the threatened bald eagle and Mexican spotted owl (Strix occidentalis lucida). The Forest Service also determined that the proposed project would not affect the Mexican gray wolf (Canis lupus baileyi) and peregrine falcon and would not jeopardize the continued existence of the proposed endangered jaguar (Panthera onca). The Service concurs with the findings for the Mexican spotted owl, Mexican gray wolf, and jaguar. Because of unsuitable habitat or other factors, it is unlikely these four

species are in the action area. Therefore, effects to these species are not expected or are expected to be insignificant and/or discountable due to extremely low level and/or probability.

The Service does not concur with the Forest Service's findings for razorback sucker, southwestern willow flycatcher, bald eagle, or peregrine falcon. Based on our nonconcurrence we are providing this biological opinion on razorback sucker, southwestern willow flycatcher, bald eagle, and peregrine falcon, as requested in your February 13, 1997, letter.

CONSULTATION HISTORY

The proposed project requires action on the part of two Federal agencies; the Forest Service, which manages portions of the land on which the road is located, and the COE, which must authorize dredging and filling in the Blue River under section 404 of the Clean Water Act. The Forest Service has, with the consent of COE, taken the role of lead agency for this consultation. This biological opinion, including the incidental take statement, applies to both agencies, as appropriate under their differing authorities.

The following is a summary of the major events in this consultation. This consultation has been ongoing in emergency, informal, and formal stages for over four years and includes six emergency consultations, one informal concurrence, and formal consultation on the BMPs. Table 1, at the end of this section, provides a listing of events in the consultation.

Although the need for ESA compliance on the Blue River road and its suitability for a programmatic approach, such as BMPs, had been informally discussed via telephone between the Alpine Ranger District and the Service prior to summer 1993, specific informal consultation on the Blue River road began in August 1993 with a telephone call from Greenlee County to the Service inquiring about ESA compliance regarding use of Federal Emergency Management Agency (FEMA) funds for flood repair work on the road. Exchange of information between the Service, FEMA, and the Forest Service led to a site visit on March 9, 1994, with the Service, Forest Service, FEMA, Arizona Department of Emergency Management (ADEM), and Greenlee County personnel at which the need for compliance with ESA and section 404 of the Clean Water Act was discussed for two specific repair sites, one of which was termed the *Sawmill* site. Other repair work from flooding of late winter 1993 had already been completed by the County. During the site visit, the Service pointed out the need for geomorphologic studies and a multi-party effort to seek a long-term solution that would serve the needs of area residents as well as removing or minimizing adverse effects to listed species and the natural resources.

Between November 1994 and March 1995, six emergency consultations were conducted on flood repair of the Blue River road under the emergency consultation provisions of the section 7 regulations (50 CFR Part 402.05). The COE is the action agency for five of those emergency

consultations and the Forest Service is the action agency for the other one. The emergency consultation regulations require that formal consultation be initiated by the action agency as soon as practicable after the emergency is under control. No request for formal consultation has been received from either the Forest Service or COE on any of the six emergency consultations; however, it has been discussed in meetings and telephone calls that the emergency consultations could be finalized in the same biological opinion as for the BMPS. Therefore, formal consultation for all six of the emergency consultations is being finalized in this biological opinion.

While informal consultation and other environmental compliance was ongoing on the final repairs from the flooding of winter 1992/3, the Blue River flooded again in early November 1994. The Forest Service notified the Service on November 22 that repair work was underway but did not request consultation. On December 2, the Service received an anonymous call from a concerned public about the extensive road work on the Blue River road and its effects to the river. The Service contacted the Forest Service on December 5 and was told that the Forest Service had authorized the work under the understanding that the FEMA enabling legislation, the Stafford Act, precluded the need for environmental compliance. Extensive repair work had already been carried out, including part of the work on the two sites visited in March 1994 and for which FEMA was in the process of National Environmental Policy Act (NEPA) and ESA compliance. The Service contacted COE and FEMA about the situation. The COE called Greenlee County and arranged for a halt to the work pending discussions. An emergency consultation, with COE as lead agency, was documented with a letter from the Service on December 7, 1994. The emergency consultation covered minimal repairs to provide access for area residents. It did not authorize work on the two sites under earlier informal consultation. Seven conditions were given to minimize adverse effects and provide for documentation.

A site visit was held on December 13, 1994, with the Service, Forest Service, ADEM, COE, and Greenlee County. On December 16, the Forest Service called the Service to request authorization for work to continue on the *Sawmill* site under the December 7 emergency consultation. As a bypass route passable for vehicles was available, the Service did not concur that the *Sawmill* site repairs constituted an emergency.

In early January 1995, flooding again occurred on the upper Blue River. Emergency consultation took place, including a January 11 meeting between the Service, FEMA, Forest Service, COE, ADEM, and Greenlee County, and a documenting Service letter of the same day. The COE acted as lead agency. Eight conditions were given to minimize adverse effects and provide for documentation, including limiting the consultation to 20 low-water crossings and to the period of January 11 to 25, 1995.

On January 6, 1995, the Service wrote to COE discussing the repair and ESA compliance needs on the Blue River road and recommending the COE take lead agency status for section 7

consultation. The Service proposed a three tiered approach to consultation and to resolution of the adverse effects of the road to the aquatic ecosystem, including emergency consultations for urgent access restoration, a programmatic plan and consultation for normal maintenance and repairs, and a multi-agency effort at finding a long-term solution.

Following closure of the *Sawmill* site temporary bypass by the private landowner a third emergency consultation was documented on January 17, 1995, for completion of the repairs at that site. The action agency for this consultation was the Forest Service. Nine conditions were given to minimize adverse effects and provide for documentation.

In anticipation of additional flooding, a fourth emergency consultation with COE was documented on January 25, 1995, to cover emergency repairs on 20 low-water crossings sufficient to allow landowner access. The consultation covered the period of January 25 to February 8, 1995. A fifth emergency consultation was initiated on the basis of anticipated additional flooding to cover the time period of February 14 to February 28, 1995. The sixth and final emergency consultation was documented on March 10, 1995, for the same 20 low-water crossings for the period of March 10 to March 31. These consultations included 8, 9, and 10 conditions, respectively, to minimize adverse effects and provide for documentation.

By early 1995, the Forest Service, County, and COE had begun work on drafting BMPs for the Blue River road. Meanwhile, there was an ongoing need for additional repairs and maintenance. Additional meetings and site visits occurred. On February 9, 1996, the Forest Service, acting as lead agency, requested Service concurrence with a finding of "is not likely to adversely affect" for loach minnow for repair work on thirteen sites along the Blue River road. The Service concurred on February 23, with conditions. Those repairs were carried out. On April 21, 1996, the Forest Service requested additional concurrence with a finding of "is not likely to adversely affect" for loach minnow for repair work at four additional sites. The Service did not reply.

The Forest Service completed the first draft of the BMPs by December 1995. The COE provided the Forest Service with comments on the draft BMPs in February 1996 and the Service provided comments in May 1996. In addition to our comments the Service discussed the BMPs as the second in a three step process needed for resolution of environmental issues on the road and for the section 7 consultation. We recommended consolidated of the finalization of the emergency consultations with the BMPs, as one biological opinion.

On November 15, 1996, Service, Forest Service, ADEM, and County representatives met at the home of Bill and Barbara Marks on the Blue River to discuss the Blue River road informal consultation and work out changes in the draft BMPs. During discussion of the need to expedite this consultation, the group addressed the relative priority to the Forest Service of the Blue River road consultation and the San Francisco River road repair project, which was at that time already

in formal consultation. Because of limited Service staff time and the need to meet deadlines for use of State emergency funding on both projects, the Service representative recommended the Forest Service decide which of two pending consultations was of highest priority to them, this received Field Supervisor concurrence on November 20, 1996, and was conveyed by telephone on the same day to Charlie Denton, Alpine District Ranger, by Sally Stefferud, of the Service's Arizona Ecological Service Field Office. The agreement was that the San Francisco River road consultation would be extended and the Blue River road consultation shortened to put both consultations on the same timeline for delivery of biological opinions by May 1, 1997, with the actual on-the-ground work to be completed by September 30, 1997. Based on that agreement, the ADEM requested extension of the State emergency funding for the two projects (memorandum to the Service from Hugh Fowler, Assistant Director of Disaster Recovery, November 19, 1996). The draft BMPs were submitted by the Forest Service and COE for formal consultation on February 13, 1997. The formal consultation period began on February 14, the date the initiation letter was received by the Service.

On May 7, 1997, the Service informed both the Forest Service and COE, via telephone of the possibility that the proposed project might jeopardize the continued existence of loach minnow, and opened discussions regarding potential project changes that might avoid that possibility. Between May 7 and June 13, telephone and fax communications resulted in revision of the BMPs, addition of initial provisions for long-term planning, and reduction of the proposed project period from 5 years to an interim period of 12 months.

TABLE 1. CHRONOLOGY OF EMERGENCY, INFORMAL, AND FORMAL CONSULTATION FOR BLUE RIVER ROAD MAINTENANCE AND REPAIR[1]

DATE	EVENT
1993	
Jan.-Feb. 93	Major flooding throughout Arizona, including Blue River
spring 1993	Telephone calls between Forest Service and Service
3/93	FEMA submittal of over 500 flood repair projects for Service review, including Blue River road projects

[1]Table 1 abbreviations include: FEMA, Federal Emergency Management Agency; ESA, Endangered Species Act; AGFD, Arizona Game and Fish Department; ADEM, Arizona Division of Emergency Management; COE, Corps of Engineers; 404, section 404 of the Clean Water Act; NEPA, National Environmental Policy Act; BMPs, Best Management Practices.

8/17/93	Telephone call Greenlee County to Service inquiring about need for ESA compliance for FEMA funding on road work
8/26/93	Meeting FEMA, Service, AGFD, ADEM to discuss projects considered for FEMA funding and their need for environmental compliance
9/10/93	FEMA letter to Forest Service inquiring about status of environmental compliance on Blue River road repairs
9/23/93	Forest Service letter to FEMA regarding status of environmental compliance on road repairs
11/3/93	FEMA transmittal of Forest Service reply to Service
1994	
3/8/94	Site visit, Service, Forest Service, ADEM, FEMA, County
3/9/94	Service contacts COE regarding 404 permit needs on Blue River road repairs
spring/ summer 1994	Miscellaneous contacts among Service, FEMA, and COE regarding NEPA and ESA compliance underway by FEMA
11/12/94	Flooding on Blue River
11/21/94	Forest Service contacts Service regarding ESA compliance on flood repair work already underway on Blue River road
11/22/94	Forest Service letter to Service reporting repair work underway on Blue River road
12/2/94	Private anonymous citizen complaints to Service regarding environmental impacts of Blue River road repair work
12/5/94	Telephone calls between Service, Forest Service, COE, FEMA, and County regarding repair work. COE requests County to halt work pending discussions on environmental compliance
12/5,6/94	More flooding on Blue River
12/6/94	Telephone emergency consultation between Service, FEMA, COE, Forest Service, and County for minimal repairs to allow vehicular access on Blue River road
12/7/94	Letter Service to COE confirming the telephone emergency consultation of 12/6/94
12/8/94	Letter COE to County authorizing emergency repairs
12/13/94	Site visit, Service, Forest Service, COE, ADEM, and County to look at further repair needs
12/16/94	Telephone call Forest Service to Service requesting ESA clearance for additional work -- Service does not concur
1995	
1/5/95	More flooding on Blue River

1/5/95	Telephone calls between Forest Service, Service, and COE
1/6/95	Letter Service to COE outlining emergency, interim, and long-term ESA compliance needs
1/10/95	Meeting, Service and COE to discuss emergency, interim, and long-term procedures and plans for 404 and ESA compliance for Blue River road
1/11/95	Meeting Service, Forest Service, COE, ADEM, FEMA, County, and private landowners discussing 404 and ESA compliance needs in emergency, interim, and long-term
1/11/95	Letter Service to COE documenting second emergency consultation for 20 low-water crossings for January 11 to 25, 1995 period
1/12/95	Letter COE to County authorizing work on 20 low-water crossings per emergency consultation
1/12/95	Telephone call Service to County committing to emergency consultation 3 by January 17
1/12,13/95	Telephone calls Service, Forest Service, County, FEMA, and AGFD updating information on progress of emergency consultations
1/17/95	Letter Service to Forest Service documenting third emergency consultation, allowing repair of one site
1/18,19/95	Telephone calls between Service, County, and FEMA regarding third emergency consultation
1/20/95	Telephone call County to Service obtaining amendment to third emergency consultation
1/24/95	Telephone call from County to Service warning of new flooding expected and requesting additional emergency consultation
1/24/95	Telephone call Service, COE, and County requesting fourth emergency consultation
1/25/95	Telephone call Service to Forest Service informing them of fourth emergency consultation
1/25/95	Letter Service to COE documenting fourth emergency consultation for 20 low-water crossings for period of January 25 to February 8, 1995
1/27/95	Letter COE to County authorizing repair work per fourth emergency consultation
2/13/95	Telephone call County to Service warning of additional flooding expected
2/95	COE and County begin development of BMPs
2/14/95	Telephone call Service, COE, and County requesting fifth emergency consultation
2/14/95	Telephone call Service to Forest Service informing them of fifth emergency consultation
2/14/95	Letter Service to COE documenting fifth emergency consultation for 20 low-water crossings for period of February 14 to 28, 1995
2/22/95	Letter COE to County authorizing repair work per fifth emergency consultation
3/6/95	Telephone call County to Service warning of additional flooding expected
3/8/95	Telephone call County, COE, and Service requesting sixth emergency consultation

3/9/95	Telephone call Service to Forest Service informing them of sixth emergency consultation
3/9/95	Letter Service to COE documenting sixth emergency consultation for 20 low-water crossings for period of March 10 to 31, 1995
3/15/95	Meeting Service, COE, Forest Service, County, ADEM, and Congressional delegation representatives to discuss progress on repairs and process for interim (BMPs) and long-term environmental compliance
3/21/95	Forest Service begins work on BMPs and requests County information by letter, phone and in person
6/12/95	Site visit by Service biologists and hydrologist
12/14/95	Draft BMPs sent to Service by Forest Service for review
1996	
2/7/96	Meeting and site visit, Service, ADEM, Forest Service, County, ADEM, and AGFD to discuss BMPs and need for environmental clearance for some work prior to finalization of BMPs
2/9/96	COE submits review of Forest Service draft BMPs
2/9/96	Letter Forest Service to Service requesting informal consultation concurrence with finding of "is not likely to adversely affect" loach minnow for repair work on 13 sites along road
2/23/96	Letter Service to Forest Service concurring with finding of "is not likely to adversely affect" loach minnow on repair work at 13 sites
3/22/96	Letter Forest Service to Service requesting informal consultation concurrence with finding of "is not likely to adversely affect" loach minnow for repair work at 4 additional sites
5/22/96	Letter Service to Forest Service with comments on draft BMPs
6/13/96	Letter COE to Forest Service agreeing to Forest Service as lead agency for BMP consultation
9/17/96	Meeting Service and Forest Service to discuss changes to draft BMPs to incorporate Service comments
11/19/96	Meeting and site visit Service, Forest Service, ADEM, County to discuss gravel mining issues in draft BMPs. Agreement was reached to complete formal consultation by May 1, 1997.
11/20/96	Telephone call Service to Forest Service confirming agreement for May 1, 1997 due date on consultation
12/6/96	Fax Forest Service to Service transmitting gravel mining additions to draft BMPs
1997	
1/15/97	Letter Forest Service to Service transmitting photos on gravel mining sites
2/13/97	Letter Forest Service to Service requesting initiation of formal consultation on draft BMPs

2/14/97	Forest Service request for initiation received - formal consultation initiated
4/14/97	Telephone call Service to Forest Service requesting clarification that Forest Service initiation should include COE as a joint consulting agency
4/17/97	Telephone call Service to Forest Service requesting clarification of scope of roads included in consultation
4/18/97	Draft project description section for biological opinion sent (fax) to Forest Service and COE for review
4/21/97	Telephone call COE to Service with comments agreement with draft project description
4/24/97	Telephone call Service to Forest Service requesting additional information on extent of peregrine falcon habitat in action area.
4/30/97	Telephone call Forest Service to Service with peregrine falcon habitat information
5/6/97	Telephone call Service to Forest Service to obtain Forest Service comments and approval of draft project description
5/7/97	Telephone calls Service to Forest Service and COE discussing possibility of jeopardy opinion and ways to amend project description to avoid that finding
5/20-28/97	Telephone calls between Service, COE, and Forest Service discussing possible are revisions to project description
5/21/97	Portions of draft opinion sent (via fax) by Service to Forest Service (environmental baseline, effects, reasonable and prudent alternative)
5/28/97	Portions of draft opinion (environmental baseline, effects, reasonable and prudent alternative) hand delivered to COE by Service
5/30/97	Forest Service site visit to select gravel mining sites for BMP revision
6/5/97	Draft revisions to BMPs and long-term planning sent (via fax) from Forest Service to Service
6/5/97	Telephone call Forest Service and Service regarding changes to project description and discussing potential for an opinion for a reduced interim period to avoid jeopardy
6/5/97	Service comments on draft project revisions sent (via fax) to Forest Service
6/9/97	Proposed interim project description sent (via fax) to Forest Service from Service
6/10/97	Telephone call Service to Forest Service inquiring about finalization of proposed project description
6/11/97	Telephone call Service to COE discussing proposed interim project description
6/11/97	Final BMPs faxed from Forest Service to Service
6/13/97	Final BMPs formally transmitted Forest Service to Service

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The proposed project is the interim authorization of normal maintenance and repair, using BMPs, of the roads maintained by Greenlee County on the upper Blue River in Greenlee County, Arizona for a period of 12 months (beginning with the date of this opinion), the formation of a multi-party team to evaluate long-term solutions to road issues, and development of study plans for geomorphic, hydrologic, and biologic studies to provide the information needed to implement a long-term solution. The roads subject to consultation run along approximately 30 miles of the upper Blue River and its tributaries, Campbell Blue and Dry Blue Creeks in Township 4 1/2N, Range 30E, sections 18, 19, 30, 31, and 32; T.4N., R.32E., secs. 5, 7, and 8; T.4N., R.31E., secs., 24, 25, 36; T.3N., R31E., secs. 1, 11, 12, 14, 15, 20, 21, 22, 29, 30, 31; T.3N., R.30E., sec. 36; T.2N.,R.30E., secs. 1, 2, 11, 12, 14, 23, 26; and T.7S., R.21W., secs. 5, 6, and 7 (Figure 1).

The roads included in this consultation and to which the BMPs would be applied are as follows:

- FR 281 from 2 miles above its junction with FR 30 downstream to a private inholding in sec. 14, T.2N., R.30E. (approximately 27 miles of road),

- FR 30 from the private inholding in sec. 35, T.4 1/2N., R.31E. downstream to the junction with FR 281 (approximately 3 miles of road),

- FR 16 from the private inholding in sec. 5, T.7S., R.21W. downstream to the junction with FR 281 (approximately 0.75 miles of road),

- FR 567 within the Blue River drainage (approximately 12 miles of road),

- FR 232 within the Blue River drainage (approximately 4 miles of road), and

- all spur roads to FR 281, 30, and 16 that are maintained, either formally or informally, by Greenlee County (mileage unknown).

The maintenance and repair using the BMPs, and this opinion on those actions, apply to these roads both on Forest Service and private lands. The actual implementation would be by Greenlee County, which maintains and repairs the road. The Federal actions under consultation on Forest Service lands are the authorizations provided by the Forest Service for Forest lands

and by COE under section 404 of the Clean Water Act. The Federal action under consultation on private lands is the authorization by COE under section 404.

Maintenance and repair work on the existing roads includes work on bridges, low-water crossings, culverts, roadbanks, roadbeds, road surfaces, slides, cattleguards, and protective structures, such as existing dikes, riprap, and gabions. Normal maintenance work tends to be focused on certain areas, such as low-water crossings and roadbeds on the outside of stream meanders. However, normal maintenance and repair work could occur along any portion of the roads covered by the BMPs and could occur at any time of the year.

The roads addressed in this consultation are all-weather gravel roads. They receive light to moderate use. The Forest Service estimates that FR 281 receives average daily travel of 100 vehicles or less, rising to 300 vehicles per day during hunting season (Oldfield, 1996).

From Alpine, Arizona, FR 281 descends into the Blue River drainage along Turkey Creek, a tributary of Campbell Blue Creek. At the point where it reaches Campbell Blue Creek, the road splits. Turning upstream on Campbell Blue Creek, Forest Road 30 runs along the narrow valley bottom on the north side of the creek on Forest land for about 3 miles ending at a private inholding in T.4 1/2 N., R.31E., sec. 35 (Luce Ranch). All tributaries coming into Campbell Blue Creek from the north are intermittent or ephemeral and the road crosses them by low-water ford crossings. The ford crossing on Turkey Creek is a concrete pad and is known as the Luce crossing. There are no spur roads to FR 30 that are subject to County maintenance or repair work (see Table 2).

Turning downstream, FR 281 runs along the north side of the gradually widening valley bottom for not quite 2 miles before it crosses Campbell Blue Creek via bridge. There are four bridges on intermittent tributaries in this stretch. There is one spur road low-water crossing (Kilgore) of Campbell Blue Creek subject to County maintenance and repair. In this stretch, less than one-half mile of the road is on private land and the remainder is on Forest land.

Just before reaching the first bridge, FR 16 joins FR 281. Forest Road 16 runs along the east side of Campbell Blue Creek and turns up the northwest side of Dry Blue Creek for about 0.5 miles to a private inholding in T.5S., R.21W., secs. 5 and 6. There are two low-water crossings of Dry Blue Creek on FR 16 and spurs (Hoffman and Sutcliff) accessing private residences which are subject to County maintenance and repair. Although FR 16, and about 0.75 miles of FR 281, actually lie in New Mexico, they are maintained by Greenlee County. This stretch is on Forest lands except for very short pieces at the end, which are on private inholdings.

TABLE 2. SUMMARY DATA ON MILEAGES AND OWNERSHIP OF COUNTY MAINTAINED ROADS IN UPPER BLUE RIVER DRAINAGE, GREENLEE COUNTY, ARIZONA[2]

Road Stretch	Total Miles	Private land	Forest Service land	Number bridges[3]	Number low-water crossings[3]	Number spur road low-water crossings[3]
FR 30	3	0	3	0	0	0
FR 16	0.75	≤0.1	≥0.65	0	1	1
FR 281, along Turkey Ck	2	0	2	0	0	0
FR 281, Turkey Ck to Joy Crossing	13	4.75	8.25	4	1	6
FR 281, Joy Crossing to end of road (Robart ranch)	11.25	2.5	8.75	0	3	10
FR 567	12	0.5	11.5	0	0	0
FR 232	4	<0.2	<3.8	0	0	0
TOTALS	**46**	**8**	**38**	**4**	**5**	**17**

Below the bridge, FR 281 continues along the west side of the Blue River valley floor for about 2.5 miles where it again crosses the Blue River via bridge (Maness). There is one bridge on a side tributary along the main road in this stretch. There are also two spur road low-water crossings (Rimsza and Maness) of the Blue River on which the County does maintenance and repair work. About one-third mile of this stretch is on private land with the rest on Forest land.

From Maness bridge, FR 281 parallels the east side of the Blue River for about 2 miles to a third bridge across the Blue River (Burnt). There are no spur road low-water crossings of the Blue River in this stretch. Less than one-tenth of a mile of this stretch is on private land. After Burnt bridge, FR 281 runs along the west side of the Blue River for slightly over 2 miles to a fourth mainstem bridge (Lyons). There are no spur low-water crossings of the Blue River in this stretch. Less than one-tenth of a mile of this stretch is on private land.

---

[2]Does not include mileage of private spur roads maintained by the County.

[3]On Blue River, Campbell Blue or Dry Blue Creeks only. Bridges on other tributary streams not included.

Forest road 281 stays on the east side of the Blue River for about 4.25 miles below Burnt bridge, and then crosses the river in an unhardened low-water ford crossing (Joy). There are three bridges on side tributaries in this stretch. There are three low-water crossings of the Blue River on spur roads (Quinsler, Cemetery, and Hamblin) and one low-water crossing with a concrete pad on FR 567 (Red Hill road/Blue Crossing) which joins 281 after descending the west side of the Blue River drainage. Just before Joy Crossing, FR 232 joins 281 after descending into the drainage from the east. About 2.25 miles of this stretch are on private land and the remaining 2 on Forest land.

At Joy crossing, a private fish hatchery is present on the west side of the Blue River, supported by diversion of the river. Shortly beyond Joy crossing, FR 281 climbs onto the hillside above the valley bottom for a little more than a mile before descending into the valley bottom again. At 3.5 miles below Joy crossing, FR 281 crosses the Blue River in another unhardened low-water ford (Balke). In this stretch there are four low-water crossings of the Blue River on spur roads (Bush, Gaddy, Marks, and Lamphier) maintained and repaired by the County. About 1 mile of this stretch of FR 281 is on private land.

Below Balke crossing, FR 281 climbs onto the hillside on the east side of the river for about 1.5 miles. It then descends back to the valley bottom where it continues for about another 3 miles to cross the river on an unhardened low-water ford crossing at the Blue Box. In this stretch, there are four low-water crossings of the Blue River on spur roads (Fishhook, Patrick, Hale, and Steeple) that receive maintenance and repair by the County. A little less than one-half mile of the Balke to Blue Box stretch of FR 281 is on private land and the remainder is on Forest land.

Below Blue Box crossing, the road climbs the west hillside and remains above the floodplain for about 1.75 miles before descending to a low-water ford crossing of KP Creek, a perennial tributary of the Blue River. A spur road goes up KP Creek for a little less than one-half mile to a private inholding. There are two low-water ford crossings of the creek (KP-Downs 1 and KP-Downs 2) on that road that are maintained and repaired by the County. Forest Road 281 in this stretch is entirely on Forest land.

From KP Creek, FR 281 continues another approximately 1.5 miles where it ends at a private inholding. About half of this stretch is on the west hillside and not in the valley bottom. There are no spur roads maintained by the County in this stretch. About 1 mile of the road in this stretch is on private land.

Below the end of FR 281, a bladed track is sometimes present for another approximately 1.75 miles to a private inholding. There are a variable number of low-water crossings on this track, depending upon the position of the low-water channel. In 1994, there were eight. The track is not a constructed road and the BMPs are not applicable. This track does not receive regular County maintenance or repair and is not considered in this opinion. Any work on this road

requiring Forest Service or COE authorization or action may be subject to additional, separate consultation.

The portions of FRs 567 and 232 included in this opinion lie in the Blue River valley bottom only where they converge with FR 281. The uppermost 2 miles of FR 281 is also not in the Blue River valley bottom. However, these road segments are within the Blue River drainage and their presence, maintenance, and repair affect the Blue River through alteration of tributary drainages and the watershed. Of the approximately 17 miles of road in these road segments, less than 1 mile is in private ownership and the remainder is on Forest land.

The BMPs include objectives, explanations, and implementation parameters for actions that fall within nine categories. Actions which are not covered by these nine categories are outside of the BMPs and may be subject to separate, additional section 7 consultation. The purpose of these BMPs is to provide for advance planning and section 7 consultation that would help minimize and avoid adverse environmental impacts, particularly to Federally listed species, and that would avoid the need for repetitive or emergency section 7 consultations on normal maintenance and repair actions. It is anticipated that there would be need for occasional additional, project-specific, section 7 consultations for maintenance, repair, or improvement projects that are not part of the normal activities and which do not fall within the scope of the BMPs.

The nine activities covered in the BMPs include:

1. Maintenance or reconstruction of wet road crossings that ford perennial streams, including removal or recontouring of floodplain materials, placement of fill, removal of debris and vegetation, and compacting of substrate.

2. Maintenance or reconstruction of dry road crossings that cross ephemeral or intermittent streams, including removal or recontouring of floodplain materials, placement of fill, removal of debris and vegetation, and compacting of substrate.

3. Maintenance and protection of existing structures, such as culverts (pipe and box) and bridges, including smoothing, dredging, filling, widening, or narrowing the stream channel.

4. Road resurfacing.

5. Removal of slide material deposited on the road and stabilization of unstable and eroded areas related to slide areas, including sidecasting, transport to dump sites, blasting, seeding, compacting, riprapping, benching, and mulching.

6. Material gathering and gravel borrowing from road banks, the river, and floodplain, including excavation, recontouring, and stockpiling.

7. Restoration of undercut and eroded road banks by moving the road within the easement or replacing eroded material and adding bank protection, such as riprap or similar methods. This action may include relocation or channelization of the of the river.

8. River channelization, including removal of debris, construction of dikes, and rerouting of the water into earlier (pre-event) channels.

9. Routine maintenance activities including surface maintenance (primarily grading), snow removal, vegetation removal along edges, and installation and servicing of traffic and animal control devices.

The details and parameters of these actions are found in the BMPs appended to this biological opinion (Appendix 1). The BMPs note that they are intended to be a "living document" and that amendments are anticipated. It is stated that amendments or changes may be agreed to by the County and Forest Service. Since it is not possible to anticipate the effects of unknown amendments or changes to the BMPs and consider those effects in this opinion, any such changes or amendments may be subject to further section 7 consultation if they result in effects to listed species that are different from or in addition to those considered in this opinion.

The action under consultation also includes an analysis of the effects of the six emergency consultations detailed in the Consultation History section of this opinion.

In addition to finalization of the six emergency consultations and adoption of the BMPs for normal repair and maintenance activities, the Forest Service and COE believe there is a need for a long-term strategic plan for addressing the adverse road effects including accumulative aspects of the use, existence, maintenance, and repair of the County-maintained roads along and within the Blue River drainage. Therefore, as part of this proposed project, the Forest Service and COE would establish a team to begin a coordinated evaluation of long-term solutions to the road issues. This team would consist of representatives from the Forest Service, COE, Service, Greenlee County, Arizona Game and Fish Department, and other interested and/or knowledgeable parties. Within the 12-month period covered by this interim project proposal and biological opinion, the team will formulate study plans for the following:

a) Geomorphic studies that would obtain the information needed to find a way to mesh the need for maintaining a stable road with the need for stabilizing the Blue River channel into a natural geometry. These studies would also address the information needed to determine effects of various gravel mining strategies.

b) Studies of the presumed historic conditions of the aquatic and riparian habitats of the upper Blue River, their present status, and their potential for restoration.

The team will also identify a process for future actions to address the use of the study information in formulating a long-term strategic plan for the roads in the upper Blue River and alleviation of their effects on the aquatic and riparian ecosystem. The information and process developed by the team will be incorporated into a proposed project that would include use of the BMPs for a 5 year period and a mechanism by which the long-term effects to the ecosystem will be addressed and ameliorated or removed. This revised proposed project would be submitted for further section 7 consultation in sufficient time to allow for completion of a 5-year biological opinion to replace the 12-month interim coverage.

SPECIES DESCRIPTIONS AND STATUS

Loach Minnow Description and Status

Loach minnow was listed as a threatened species on October 28, 1986 (USFWS, 1986a). Critical habitat was designated for loach minnow on March 8, 1994, including portions of the San Francisco, Tularosa, and upper Gila Rivers, Aravaipa Creek, and the Blue River from Campbell and Dry Blue Creeks downstream to the confluence with the San Francisco River (USFWS, 1994a). Since critical habitat for loach minnow has been enjoined by the New Mexico District Court (Coalition of Arizona-New Mexico Counties for Stable Economic Growth vs U.S. Fish and Wildlife Service, No. 95-1285-M Civil D.N.M., filed March 4, 1997), no conferencing or consultation is required for critical habitat for this species.

Loach minnow is a small, slender, elongate fish with markedly upwardly-directed eyes (Minckley, 1973). Historic range of loach minnow included the basins of the Verde, Salt, San Pedro, San Francisco, and Gila Rivers (Minckley, 1973; Sublette *et al.*, 1990). Habitat destruction plus competition and predation by nonnative species have reduced the range of the species by about 85 percent (%) (Miller, 1961; Williams *et al.*, 1985; Marsh *et al.*, 1989). Loach minnow remains in limited portions of the upper Gila, San Francisco, Blue, Black, Tularosa, and White Rivers; and Aravaipa, Eagle, Campbell Blue, and Dry Blue Creeks in Arizona and New Mexico (Barber and Minckley, 1966; Silvey and Thompson, 1978; Propst *et al.*, 1985; Propst *et al.*, 1988; Marsh *et al.*, 1990; Bagley *et al.*, 1995).

Loach minnow is a bottom-dwelling inhabitant of shallow, swift water over gravel, cobble, and rubble substrates (Rinne, 1989; Propst and Bestgen, 1991). Loach minnow uses the spaces between, and in the lee of, larger substrate for resting and spawning (Propst *et al.*, 1988; Rinne, 1989). It is rare or absent from habitats where fine sediments fill the interstitial spaces (Propst

and Bestgen, 1991). Some studies have indicated that the presence of filamentous algae may be an important component of loach minnow habitat (Barber and Minckley, 1966). The life span of loach minnow is about 2 years (Britt, 1982; Propst and Bestgen, 1991). Loach minnow feeds exclusively on aquatic insects (Schreiber, 1978; Abarca, 1987). Spawning occurs in March through May (Britt, 1982; Propst *et al.*, 1988); however, recent reports have confirmed that under certain circumstances loach minnow also spawn in the autumn (Vives and Minckley, 1990). The eggs of loach minnow are attached to the underside of a rock that forms the roof of a small cavity in the substrate on the downstream side. Limited data indicate that the male loach minnow may guard the nest during incubation (Propst *et al.*, 1988; Vives and Minckley, 1990).

Recent biochemical genetic work on loach minnow indicate there are substantial differences in genetic makeup between remnant loach minnow populations. Remnant populations occupy isolated fragments of the Gila River basin and are isolated from each other. Based upon her work, Tibbets (1992) recommended that the genetically distinctive units of loach minnow should be managed as separate units to preserve the existing genetic variation.

The status of loach minnow is declining rangewide. Although it is currently listed as threatened, the Service has found that a petition to uplist the species to endangered status is warranted. A reclassification proposal is pending; however, work on it is precluded due to work on other higher priority listing actions (USFWS, 1994b). The need for reclassification is not due to data on declines in the species itself but is based upon increases in serious threats to a large portion of its habitat.

Razorback Sucker Description and Status

The razorback sucker was listed as endangered on October 23, 1991 (USFWS, 1991). Critical habitat was designated for razorback sucker on March 21, 1994 (USFWS, 1994c). Within the Gila River basin, critical habitat includes portions of the Gila, Verde and Salt Rivers. Critical habitat includes the river and its 100-year floodplain. Razorback sucker grows to over two feet in length and has a distinctive abrupt, sharp-edged dorsal ridge behind the head (Minckley, 1973). The species was once common throughout the Colorado River basin, but is now rare, occurring sporadically in about 750 miles of the upper basin (Bestgen, 1990). In the lower basin a substantial population exists only in Lake Mohave. Upstream from Lake Mohave, the razorback sucker occurs in Lake Mead and Grand Canyon. Downstream from Lake Mohave, it occurs sporadically in the mainstem and associated impoundments and canals (USFWS, 1991). Habitat alteration and destruction along with competition and predation from introduced nonnative fish species are responsible for the species' decline (Marsh and Brooks, 1989; Minckley *et al.*, 1991). As part of the recovery program, reintroduction of razorback sucker

has been attempted through stocking into numerous locations in the Gila, Salt, and Verde River basins, including the Blue River (Creef *et al.*, 1992; Hendrickson, 1993).

Adult razorback sucker inhabit a wide variety of riverine habitats including mainstream and backwater areas such as slow runs, deep eddies, pools, and sloughs (Bestgen, 1990). It also inhabits reservoirs. Larval and juvenile razorback sucker habitat use is poorly understood, but is thought to be shallow, slow moving areas, backwaters and littoral zones (Langhorst and Marsh, 1986; Bestgen, 1990). Razorback sucker spawns from January to May and initiation of spawning appears to be tied to water temperature (Langhorst and Marsh, 1986; Tyus and Karp, 1990). Spawning occurs in shallow water over large gravel, cobble, or coarse sand with little or no fine sediment on wave-washed lakeshores or riverine riffles (Minckley *et al.*, 1991). Razorback sucker lives up to about 50 years (McCarthy, 1987). It feeds on plankton, algae and detritus in reservoirs, with riverine populations also consuming a large amount of benthic invertebrates (Bestgen, 1990).

Bald Eagle Description and Status

The bald eagle south of the 40th parallel was listed as endangered under the Endangered species Act of 1966 on March 11, 1967 (USFWS, 1967). It was reclassified to threatened status on July 12, 1995 (USFWS, 1995a). No critical habitat has been designated for this species. The bald eagle is a large hawk that historically ranged throughout North America except extreme northern Alaska and Canada and central and southern Mexico. Bald eagles nested on both coasts of the United States, from Florida to Baja California in the south and from Labrador, New Foundland, to the Aleutian Islands, Alaska, in the north.

The bald eagle occurs in association with aquatic ecosystems, frequenting estuaries, large lakes, reservoirs, major rivers, and some seacoast habitats. Suitable habitat for bald eagles includes those areas with an adequate food base, perching areas, and nesting sites. In winter, bald eagles often congregate at specific wintering sites that are generally close to open water and that offer good perch trees and night roosts (USFWS, 1995a).

There were an estimated one-quarter to one-half million bald eagles on the North American continent when Europeans first arrived. Initial population declines probably began in the late 1800s, and coincided with declines in the number of waterfowl, shorebirds, and other prey species. Direct killing of bald eagles was also prevalent. Additionally, there was a loss of nesting habitat. These factors reduced bald eagle numbers until the 1940s when protection for the bald eagle was provided through the Bald Eagle Protection Act (16 U.S.C. 668). The Act accomplished protection and a slower decline in bald eagle populations by prohibiting numerous activities adversely affecting bald eagles and increasing public awareness of bald eagles. The widespread use of dichloro-diphenyl-trichloroethane (DDT) and other organochlorine compounds

in the 1940s for mosquito control and as a general insecticide caused additional declines in bald eagle populations. DDT accumulated in individual birds following ingestion of contaminated food. DDT breaks down into dichlorophenyl-dichloroethylene (DDE) and accumulates in the fatty tissues of adult females, leading to impaired calcium release necessary for egg shell formation. Thinner egg shells led to reproductive failure, and is considered a primary cause of declines in the bald eagle population. DDT was banned in the United States in 1972 (USFWS, 1995a).

Since listing, bald eagles have increased in number and expanded in range due to the banning of DDT and other persistent organochlorine compounds, habitat protection, and recovery efforts. Surveys in 1963 indicated 417 active nests in the lower 48 states with an average of 0.59 young produced per nest. In 1994, 4,450 occupied breeding areas were reported with an estimated average of 1.17 young produced per occupied nest (USFWS, 1995a).

Hunt *et al.* (1992) summarize the earliest records of bald eagles in the literature for Arizona. Coues noted bald eagles in the vicinity of Fort Whipple (now Prescott) in 1866, and Henshaw reported bald eagles south of Fort Apache in 1875. The first bald eagle breeding information was recorded in 1890 near Stoneman Lake by S.A. Mearns. Additionally, Bent reported breeding eagles at Fort Whipple in 1866 and on the Salt River Bird Reservation (since inundated by Roosevelt Lake) in 1911. Additionally, there are reports of bald eagles along rivers in the White Mountains from 1937, and reports of nesting bald eagles along the Salt and Verde Rivers as early as 1930.

From 1970 to 1990, 226 known eaglets fledged in Arizona, for an average of 10.8 young produced per year. Successful nests contained an average of 1.6 young per year (Hunt *et al.*, 1992). In 1995, there were 36 known breeding areas, with 30 of those being occupied. Within those breeding areas, 22 nests were active, and six nests failed. Sixteen of the 22 nests were successful in producing young, and a total of 28 young hatched. Twenty-five of these young survived to fledge (Beatty *et al.*, 1995). Results for the 1996 breeding season are not yet available.

In addition to breeding bald eagles, Arizona provides habitat for wintering bald eagles, which migrate through the state between October and April each year. For 1996, the standardized statewide 1996 Arizona winter count totalled 361 bald eagles, including 232 adults, 127 subadults, and two of unknown age. The most concentrated population of wintering bald eagles is found at Lake Mary and Mormon Lake, where 69 birds were located (Beatty and Driscoll, 1996).

It is not known if the population of bald eagle in Arizona declined as a result of DDT contamination because records were not consistently kept during this time period. However, the possibility for contamination was present as DDT was used in Arizona and Mexico. Use of

DDT in Mexico could potentially have contaminated waterfowl that then migrated through Arizona in addition to directly affecting juvenile and subadult eagles that travelled into Mexico. Many of the nest sites in Arizona are in rugged terrain not suitable for agricultural development, and may therefore have avoided the direct effects of DDT (Hunt *et al.*, 1992).

Bald eagle breeding areas in Arizona are predominantly located in the upper and lower Sonoran life zones. The Luna Lake breeding area is unique in Arizona in that it is found in coniferous forests at Luna Lake, as opposed to occurring in Sonoran vegetation communities. All breeding areas in Arizona are located in close proximity to a variety of aquatic habitats including reservoirs, regulated river systems, and free-flowing rivers and creeks. The alteration of natural river systems has been both beneficial and detrimental to the bald eagle. While large portions of riparian forests were inundated or otherwise destroyed following construction of dams and other water developments, the reservoirs created by these structures enhance habitat for the waterfowl and fish species on which bald eagles prey.

Arizona bald eagles are considered distinct behaviorally from bald eagles in the remaining lower 48 states in that they frequently construct nests on cliffs. Of 111 nests known in 1992, 46 were in trees, 36 on cliffs, 17 on pinnacles, 11 in snags, and one on an artificial platform. However, while there were more nests in trees, one study found that cliff nests were selected 73 percent of the time, while tree nests were selected 27 percent of the time. Additionally, eagles nesting on cliffs were found to be marginally more successful at reproducing. Bald eagles in the southwest are additionally unique in that they lay eggs in January or February, which is early compared with bald eagles in other areas. It is believed that this is a behavioral adaptation to allow chicks to avoid the extreme desert heat of midsummer. Young eagles will remain in the vicinity of the nest until June (Hunt *et al.*, 1992).

Bald eagles in Arizona consume a diversity of food items, including some invertebrates. However, their primary food is fish, which are generally consumed twice as often as birds, and four times as often as mammals. Bald eagles are known to catch live prey, steal prey from other predators (especially osprey), and use carrion. Carrion constitutes a higher proportion of the diet for juveniles and subadults than it does for adult eagles. Diet varies depending on what species are available locally. This can be affected by the type of water system on which the breeding area is based (Hunt *et al.*, 1992).

A recovery plan was developed for bald eagles in the southwest recovery region in 1982. Goals of the recovery plan were to achieve an overall reproductive output of 10 to 12 young per year and to determine occupancy of one or more pairs on a drainage other than the Salt or Verde Rivers. These goals have been met, and the bald eagle was reclassified nationwide to threatened status. While bald eagles in the southwest were initially considered a distinct population, the final rule notes that the Service has determined that bald eagles in the southwestern recovery region are part of the same bald eagle population found in the remaining lower 48 states.

While the bald eagle has been reclassified to threatened, and although the status of the birds in the southwest recovery region is on an upward trend, the population remains small and under threat from a variety of factors. Threats persist largely due to the proximity of bald eagle breeding areas to major human population centers. Additionally, because water is a scarce resource in the southwest recovery region, recreation is concentrated along available water courses. Some of the threats and disturbances to bald eagle include entanglement in monofilament (fishing line) and fishing hooks, overgrazing and related degradation of riparian vegetation, shooting, alteration of water systems for water distribution systems, maintenance of existing water development features such as dams or diversion structures, and disturbance from recreation. The use of breeding area closures and close monitoring through the Bald Eagle Nestwatch program have been and will continue to be essential to the recovery of this species.

Southwestern Willow Flycatcher Description and Status

The southwestern willow flycatcher was proposed for listing as endangered, with critical habitat, on July 23, 1993 (USFWS, 1993). A final rule listing the southwestern willow flycatcher as endangered was published on February 27, 1995 (USFWS, 1995b). The listing became effective on March 29, 1995. Following the review of comments received during the public comment period, the Service deferred the designation of critical habitat, invoking an extension on this decision until July 23, 1995. A moratorium on listing actions under the Act, passed by Congress in April 1995, required the Service to cease work on the designation of critical habitat. The proposed critical habitat includes areas in California, New Mexico, and Arizona. In Arizona, proposed critical habitat includes portions of the San Pedro, Verde, Colorado, and Little Colorado Rivers.

The States of California and New Mexico also list the southwestern willow flycatcher as endangered (CA Dept. of Fish and Game, 1992; NM Dept. of Game and Fish, 1988). The state of Arizona considers the southwestern willow flycatcher a species of special concern (AGFD, 1996).

The southwestern willow flycatcher is a small passerine bird (Order Passeriformes; Family Tyrannidae) measuring approximately 15 centimeters (cm) (5.75 inches) in length from the tip of the bill to the tip of the tail and weighing only 11 grams (0.4 ounces). It has a grayish-green back and wings, whitish throat, light gray-olive breast, and pale yellowish belly. Two white wingbars are visible (juveniles have buffy wingbars). The eye ring is faint or absent. The upper mandible is dark, the lower is light yellow grading to black at the tip.

As its name implies, the willow flycatcher is an insectivore typically perching on a branch and making short direct flights, or sallying, to capture flying insects. The southwestern willow flycatcher is a riparian obligate, nesting along rivers, streams, and other wetlands where dense

growths of willow (Salix sp.), Baccharis sp., buttonbush (Cephalanthus sp.), boxelder (Acer negundo), saltcedar (Tamarix sp.) or other plants are present, often with a scattered overstory of cottonwood (Populus sp.) and/or willow.

Empidonax traillii extimus is one of four currently-recognized willow flycatcher subspecies (Phillips, 1948; Unitt, 1987; Browning, 1993). It is a neotropical migratory species that breeds in the southwestern United States and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips, 1948; Stiles and Skutch, 1989; Peterson, 1990; Ridgely and Tudor, 1994; Howell and Webb, 1995). The historical range of the southwestern willow flycatcher included southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Utah, extreme southern Nevada, and extreme northwestern Mexico (Sonora and Baja) (Unitt, 1987).

Life History - No information is available on specific prey species. However, fecal samples containing identifiable invertebrate body parts were collected during banding operations from more than 70 southwestern willow flycatchers in California, Arizona, and southwestern Colorado (M. Sogge, pers. com.).

The southwestern willow flycatcher begins arriving on breeding grounds in late April and May (Sogge and Tibbitts, 1992; Sogge *et al.*, 1993; Muiznieks *et al.*, 1994; Sogge and Tibbitts, 1994; Maynard, 1995; Sferra *et al.*, 1995). Migration routes are not completely known. However, willow flycatchers have been documented migrating through specific locations and drainages in Arizona that do not currently support breeding populations, including the upper San Pedro River (BLM, unpubl. data), Colorado River through Grand Canyon National Park (Sogge and Tibbitts, 1992; Sogge *et al.*, 1993; Sogge and Tibbitts, 1994), lower Colorado River (Muiznieks *et al.*, 1994; Spencer *et al.*, 1996), Verde River tributaries (Muiznieks *et al.*, 1994), and Cienega Creek (BLM, *in litt.*). These observations probably include subspecies E.t. brewsteri and E.t. adastus. Empidonax flycatchers rarely sing during fall migration, so that a means of distinguishing some migrating Empidonax without a specimen is not feasible (Blake, 1953; Peterson and Chalif, 1973). However, willow flycatchers have been reported to sing and defend winter territories in Mexico and Central America (Gorski, 1969; McCabe, 1991).

Southwestern willow flycatchers begin nesting in late May and early June and fledge young from late June through mid-August (Willard, 1912; Ligon, 1961; Brown, 1988; Whitfield, 1990; Sogge and Tibbitts, 1992; Sogge *et al.*, 1993; Muiznieks *et al.*, 1994; Whitfield, 1994; Maynard, 1995). Southwestern willow flycatchers typically lay three to four eggs in a clutch (range = 2-5). The breeding cycle, from laying of the first egg to fledging, is approximately 28 days. Eggs are laid at one-day intervals (Bent, 1960; Walkinshaw, 1966; McCabe, 1991); they are incubated by the female for approximately 12 days; and young fledge approximately 12 to 13 days after hatching (King, 1955; Harrison, 1979). Southwestern willow flycatchers typically raise one brood per year but have been documented raising two broods during one

season (Whitfield, 1990). Southwestern willow flycatchers have also been documented renesting after nest failure (Whitfield, 1990; Sogge and Tibbitts, 1992; Sogge *et al.*, 1993; Muiznieks *et al.*, 1994; Sogge and Tibbitts, 1994; Whitfield, 1994; Whitfield and Strong, 1995).

Whitfield reported the following data on survivorship of adults and young: of 58 nestlings banded since 1993, 21 (36%) returned to breed; of 57 birds banded as adults (after hatch year) since 1989, 18 (31%) returned to breed at least one year (10 males, 8 females), five (9%) returned to breed for two years (all males), and two (3.5%) returned to breed for three years (M. Whitfield, Kern River Preserve, pers. com.) Whitfield (1995) also documented statistically significant variation in return rates of juveniles as a function of fledging date; approximately 21.9% of juveniles fledged on or before July 20th returned to her study area the following year, whereas only 6.4% of juveniles fledged after July 20th returned the following year.

Similar studies have been conducted for E.t. traillii in Michigan (Walkinshaw, 1966). Whitfield and Walkinshaw do not incorporate potential emigration rates into their estimates of returns and, thus, may underestimate actual survivorship. However, these data are consistent with survival rates for other passerines (Gill, 1990 chap. 21) suggesting that the lifespan of most E.t. extimus is probably two to three years (i.e. most flycatchers survive to breed one or two seasons).

Brood parasitism of southwestern willow flycatcher nests by the brown-headed cowbird (Molothrus ater) has been documented throughout the flycatcher's range (Brown, 1988; Whitfield, 1990; Muiznieks *et al.*, 1994; Whitfield, 1994; Hull and Parker, 1995; Maynard, 1995; Sferra *et al.*, 1995; Sogge, 1995b). Cowbirds lay their eggs in the nests of other species directly affecting their hosts by reducing nest success. Cowbird parasitism reduces host nest success in several ways. Cowbirds may remove some of the host's eggs, reducing overall fecundity. Hosts may abandon parasitized nests and attempt to renest, which can result in reduced clutch sizes, delayed fledging, and reduced overall nesting success and fledgling survivorship (Whitfield, 1994; Whitfield and Strong, 1995). Cowbird eggs, which require a shorter incubation period than those of many passerine hosts, hatch earlier giving cowbird nestlings a competitive advantage over the host's young for parental care (Bent, 1960; McGeen, 1972; Mayfield, 1977; Brittingham and Temple, 1983). Where studied, high rates of cowbird parasitism have coincided with southwestern willow flycatcher population declines (Whitfield, 1994; Sogge, 1995a; Sogge, 1995c; Whitfield and Strong, 1995), or, at a minimum, resulted in reduced or complete elimination of nesting success (Muiznieks *et al.*, 1994; Whitfield, 1994; Maynard, 1995; Sferra *et al.*, 1995; Sogge, 1995a; Sogge, 1995c; Whitfield and Strong, 1995). Whitfield and Strong (1995) found that flycatcher nestlings fledged after July 20th had a significantly lower return rate and that cowbird parasitism was often the cause of delayed fledging.

Habitat Use - The southwestern willow flycatcher occurs in dense riparian habitats from sea level in California to over 7000 feet in Arizona and southwestern Colorado. Throughout its

wide geographic and elevational range, its riparian habitat can be broadly described based on plant species composition and habitat structure (Sogge *et al.*, 1997). These attributes are among the most conspicuous components of flycatcher habitat but not necessarily the only important components. They are easily identified from photographs or during field visits and have been useful in conceptualizing, selecting, and evaluating suitable survey habitat. Photographs and accompanying text provided in Sogge *et al.* (1997) characterize the considerable variation in habitat structure and plant species composition found at breeding sites throughout the southwestern willow flycatcher's range. Two components that vary less across this subspecies' range are vegetation density and the presence of surface water. Those and other characteristics, such as size and shape of habitat patches, are described further below.

Based on the diversity of plant species composition and complexity of habitat structure, four basic habitat types can be described for the southwestern willow flycatcher and can be referenced with photographs provided in Sogge *et al.* (1997):

Monotypic willow: Nearly monotypic, dense stands of willow (often S. exigua or S. geyeriana) 3 to 7 meters (m) in height with no distinct overstory layer; usually very dense structure in at least lower 2 m; live foliage density is high from the ground to canopy.

Monotypic exotic: Nearly monotypic, dense stands of exotics such as saltcedar (Tamarisk sp.) or Russian olive (Elaeagnus angustifolia) 4 to 10 m in height forming a nearly continuous, closed canopy (with no distinct canopy layer); lower 2 m may be very difficult to penetrate due to branch density; however live foliage volume may be relatively low from 1 to 2 m above ground; canopy density uniformly high.

Native broadleaf dominated: Comprised of dense stands of single species (often Goodding's or other willows) or mixtures of native broadleaf trees and shrubs including, but not limited to, cottonwood, willows, boxelder, ash, buttonbush, and stinging nettle from 4 to 15 m in height; characterized by trees of different size classes; may have distinct overstory of cottonwood, willow or other broadleaf species, with recognizable subcanopy layers and a dense understory of mixed species; exotic/introduced species may be a rare component, particularly in understory.

Mixed native/exotic: Dense mixtures of native broadleaf trees and shrubs (such as those listed above) mixed with exotic species such as tamarisk and Russian olive; exotics are often primarily in the understory, but may also be a component of overstory; the native and exotic components may be dispersed throughout the habitat or concentrated as a distinct patch within a larger matrix of habitat; overall, a particular site may be dominated primarily by natives, exotics, or be a more or less equal mixture.

There are other potentially important dimensions or characteristics of southwestern willow flycatcher habitat that include the following: size, shape, and distribution of vegetation patches;

hydrology; prey types and abundance; parasites; predators; environmental factors (e.g. temperature, humidity); and interspecific competition. Underlying these are factors relating to population dynamics, such as demography (i.e. birth and death rates, age-specific fecundity), the distribution of breeding groups across the landscape, flycatcher dispersal patterns, migration routes, site fidelity, philopatry, and degree of conspecific sociality (e.g. coloniality).

The size and shape of occupied riparian habitat patches vary considerably. Southwestern willow flycatchers have been found nesting in patches as small as 0.8 hectares (ha) (e.g. Grand Canyon) and as large as several hundred ha (e.g. Roosevelt Lake, Lake Mead). When viewed from above, the mixed vegetation types in particular often appear as a mosaic of plant species and patch shapes and sizes. In contrast, narrow, linear riparian habitats one or two trees wide do not appear to contain attributes attractive to nesting flycatchers. However, flycatchers have been found using these habitats during migration.

Open water, cienegas, marshy seeps, or saturated soil are typically in the vicinity of flycatcher territories and nests; flycatchers sometimes nest in areas where nesting substrates were in standing water (Maynard, 1995; Sferra *et al.*, 1995, 1997). However, hydrological conditions at a particular site can vary remarkably in the arid Southwest within a season and between years. At some locations, particularly during drier years, water or saturated soil is only present early in the breeding season (i.e. May and part of June). However, the total absence of water or visibly saturated soil has been documented at several sites where the river channel has been modified (e.g. creation of pilot channels), where modification of subsurface flows has occurred (e.g. agricultural runoff), or as a result of changes in river channel configuration after flood events (Spencer *et al.*, 1996).

Nest Placement and Nesting Substrate - Southwestern willow flycatcher nests are open cup structures, approximately 8 cm high and 8 cm wide (outside dimensions), exclusive of any dangling material at the bottom. Nests are typically placed in the fork of a branch with the nest cup supported by several small-diameter vertical stems. Vertical stems supporting the nest cup are typically one to two cm in diameter. Spencer *et al.* (1996) measured the distance between flycatcher nests and shrub/tree center for 38 nests in monotypic saltcedar and mixed native broadleaf/saltcedar habitats. In monotypic saltcedar stands (n=31), nest placement varied from 0.0 m (center stem of shrub or tree) to 2.5 m. In the mixed riparian habitat (n=7), nest placement varied from 0.0 to 3.3 m.

Nest height relative to the base of nest substrate also varies across the southwestern willow flycatcher's range and may be correlated with height of nest substrate and/or overall canopy height. Table 3 presents data on nest heights in different riparian habitat types across the flycatcher's range. Southwestern willow flycatcher nests have been found as low as 0.6 m above the ground to 14 m above the ground. The data presented in Table 3 demonstrate that flycatchers using predominantly native broadleaf riparian habitats nest relatively low to the

TABLE 3. NEST HEIGHT AND NEST SUBSTRATE HEIGHT DATA BY RIPARIAN HABITAT TYPE FOR THE SOUTHWESTERN WILLOW FLYCATCHER

Habitat Type	n	Mean Nest Ht. Relative to Base of Nest Substrate [m] ± 1 STD (range)	Mean Nest Substrate Height [m] ± 1 STD (range)	Source
Monotypic stands of Geyer willow (Apache Co., AZ)	33	1.8 ±0.3 (1.0 - 2.3)	4.4 ±0.5 (3.5 - 6.0)	Muiznieks *et al.* (1994), Sferra *et al.* (1995) Spencer *et al.* (1996, 1997)
Mixed native broadleaf, predominantly Goodding's willow (Yuma Co., AZ)	28	2.1 ±0.8 (1.2 - 4.9)	-	H. Brown 1902 collections (T. Huels *in litt.*)
Mixed native broadleaf (Kern Co., CA)	134	2.1 ±0.1 (0.6 - 10)	5.6 ±0.3 (1 - 14)	Whitfield and Strong (1995)
Mixed native broadleaf/saltcedar (throughout AZ)	70	4.8 ±1.8 (1.5 - 10.5)	7.4 ±2.3 (3.5 - 17.0)	Muiznieks *et al.* (1994), Sferra *et al.* (1995) Spencer *et al.* (1996, 1997)
Mixed native broadleaf/exotic (Grant Co., NM)	45	7.4 ±3.6 (2.0 - 14)	12.7 ±5.2 (4 - 28)	Skaggs (1995)
Monotypic saltcedar (throughout AZ)	43	4.3 ±1.3 (2.7 - 8.0)	7.7 ±2.0 (3.4 - 12.0)	Muiznieks *et al.* (1994), Sferra *et al.* (1995) Spencer *et al.* (1996, 1997)

ground (between 1.8 m and 2.1 m on average), whereas those using mixed native/exotic and monotypic exotic riparian habitats nest relatively high above the ground (between 4.3 m and 7.4 m on average).

Historic egg/nest collections and species' descriptions from throughout the southwestern willow flycatcher's range confirm the bird's widespread use of willow for nesting (Phillips, 1948; Phillips *et al.*, 1964; Hubbard, 1987; Unitt, 1987; T. Huels, *in litt.* 1993; San Diego Natural History Museum, 1995). Of the 34 nests found by Brown in 1902 near Yuma on the lower Colorado and Gila rivers, 33 were in Goodding's willow and one was in arrowweed. Data from historic egg collections from southern California and more current studies indicate that 75 to 80% of nests were placed in willows (San Diego Natural History Museum, 1995). Currently, southwestern willow flycatchers use a wide variety of plant species for nesting substrates. At the monotypic willow stands that characterize high elevation sites in Arizona, Geyer willow was used almost exclusively for nesting (Muiznieks *et al.*, 1994). At the inflow to Lake Mead on the Colorado River, Goodding's willow was the primary nesting substrate (R. McKernan, unpubl. data). Along a 20-mile stretch of the Gila River in Grant County, New Mexico, where boxelder is the dominant understory species, 76% of flycatcher nests were placed in boxelder, with the remainder in Russian olive and saltcedar (Skaggs, 1996). At the inflows of Tonto Creek and Salt River to Roosevelt Lake in Gila County, Arizona, both of which are comprised of monotypic stands of saltcedar, 100% of flycatcher nests were placed in saltcedar (Muiznieks *et al.*, 1994; Sferra *et al.*, 1995; Spencer *et al.*, 1996; Sferra *et al.*, 1997). On the San Luis Rey River in San Diego County, California, approximately 90% of flycatcher nests were placed in live oak (Quercus agrifolia), which became the dominant plant species adjacent to the stream after willows were removed in the 1950s as a water conservation measure and a reservoir upstream reduced flood frequency and streamflow volume (San Diego Natural History Museum, 1995; W.Haas, pers. com.). Other plant species that southwestern willow flycatcher nests have been documented in include buttonbush, black twinberry (Lonicera involucrata), Fremont cottonwood, white alder (Alnus rhombifolia), blackberry (Rubus ursinus), Russian olive, and S. hindsiana.Territory Size - Southwestern willow flycatcher territory size, as defined by song locations of territorial birds, probably changes with population density, habitat quality, and nesting stage. Early in the season, territorial flycatchers may move several hundred meters between singing locations (Sogge *et al.*, 1995; Petterson and Sogge, 1996; R. Marshall, pers. obs.). Sogge *et al.* (1995) estimated a breeding territory size of 0.2 ha for a pair of flycatchers occupying a 0.6 ha patch on the Colorado River. Activity centers may expand after young are fledged but while still dependent on adults.

Distribution and abundance - The lack of systematic, rangewide collections specific to E.t. extimus preclude a complete description of this subspecies' former distribution and abundance. However, the more than 600 egg, nest, and specimen records available from museums throughout the U.S. in combination with state, county, and local faunal accounts from the first

half of the 20th Century do indicate that, historically, the southwestern willow flycatcher was more widespread and, at least, locally abundant.

Phillips (1948) first described E.t. extimus from a specimen collected by Gale Monson on the lower San Pedro River near Feldman, Arizona. Unitt (1987) reviewed historical and contemporary records of E.t. extimus throughout its range, determining that it had "declined precipitously..." and that

> *although the data reveal no trend in the past few years, the population is clearly much smaller now than 50 years ago, and no change in the factors responsible for the decline seem likely.*

Overall, Unitt (1987) documented the loss of more than 70 breeding locations rangewide, including locations along the periphery and within core drainages that form this subspecies' range. Unitt estimated that, rangewide, the southwestern willow flycatcher population probably was comprised of 500 to 1000 pairs. Below is a state by state comparison of historic and current data for the southwestern willow flycatcher. Since 1992 more than 800 historic and new locations have been surveyed rangewide to document the status of the southwestern willow flycatcher (some sites in southern California have been surveyed since the late 1980s). Survey efforts in most states were done under the auspices of the Partners In Flight program, which served as the coordinating body for survey training sessions and review and synthesis of data.

California: The historic range of E.t. extimus in California apparently included all lowland riparian areas in the southern third of the state. It was considered a common breeder where suitable habitat existed (Wheelock, 1912; Willett, 1912, 1933; Grinnel and Miller, 1944). Unitt (1984, 1987) concluded that it was once common in the Los Angeles basin, San Bernardino/Riverside area, and San Diego County. Specimen and egg/nest collections confirm its former distribution in all coastal counties from San Diego Co. to San Luis Obispo Co., as well as in the inland counties, Kern, Inyo, Mohave, San Bernardino, and Imperial. Unitt (1987) documented that the flycatcher had been extirpated, or virtually extirpated (i.e., few territories remaining) from the Santa Clara River (Ventura Co.), Los Angeles River (Los Angeles Co.), Santa Ana River (Orange and Riverside counties), San Diego River (San Diego Co.), lower Colorado River (Imperial and Riverside counties and adjacent counties in Arizona), Owen's River (Inyo Co.), and the Mohave River (San Bernardino Co.).

Survey and monitoring efforts since the late 1980s have confirmed the southwestern willow flycatcher's presence at 18 locations on 11 drainages in southern California (including Colorado River). Current known flycatcher breeding sites are restricted to three counties, San Diego, Riverside, Santa Barbara, and Kern. Combining survey data for all sites surveyed since the late 1980s for a composite population estimate, the total known southwestern willow flycatcher population in southern California is 114 territories (Table 4). Of the 18 sites where flycatchers

have been documented, 72% (13) contain five or fewer territorial flycatchers; 22% (four sites) have single pairs, or unmated territorial birds. Only three drainages are known to have 20 or more flycatcher territories, the San Luis Rey River (San Diego Co.), South Fork Kern River (Kern Co.), and Santa Ynez River (Santa Barbara Co.).

Authorized (permitted) and unauthorized activities in riparian habitats continue to adversely affect occupied flycatcher habitat in southern California. For example, approximately one kilometer (km) of occupied habitat on the Santa Ynez River in Santa Barbara County was modified or completely eliminated in 1996 when expansion of agricultural fields resulted in clearing of riparian vegetation (USFWS, *in litt.*). Despite the vast potential for riparian habitat and southwestern willow flycatcher recovery on Camp Pendleton in San Diego County, a programmatic section 7 consultation resulted in a conservation target of only 20 southwestern willow flycatcher pairs (Table 5). The Base currently has approximately 22 pairs of flycatchers, in contrast to the 348 pairs of the sympatric and endangered least Bell's vireo (Vireo bellii pusillus), which through the Base's conservation efforts increased from a low of 27 pairs in 1984. A section 7 consultation on the operations of Lake Isabella (Kern County) provided for complete, long-term inundation of the 485-ha South Fork Wildlife Area, also proposed critical habitat for the flycatcher. The Wildlife Area represents a significant recovery area occupied by 8 to 10 pairs of flycatchers prior to inundation and lies downstream of one of California's largest southwestern willow flycatcher breeding groups on the Kern River Preserve.

Arizona: Historic records for Arizona indicate the former range of the southwestern willow flycatcher included portions of all major river systems (Colorado, Salt, Verde, Gila, Santa Cruz, and San Pedro) and major tributaries, such as the Little Colorado River and headwaters, and White River. Unitt (1987) noted that "probably the steepest decline in the population levels of extimus has occurred in Arizona." The bird has been extirpated, or virtually extirpated from the Santa Cruz River (Pima Co.), upper San Pedro River (Cochise Co.), lower San Pedro River at PZ Ranch (Pinal Co.), Blue River (Greenlee Co.), Colorado River at Lees Ferry (Coconino Co.), Colorado River (Yuma Co.), Gila River (Yuma Co.), and Verde River at Tuzigoot Bridge (Yavapai Co.). Currently, 150 territories are known from 39 sites along nine drainages statewide, including the Colorado River (Table 4). As in California, the majority of breeding groups in Arizona are extremely small; of the 39 sites where flycatchers have been documented, 74% (29) contain five or fewer territorial flycatchers. Moreover, 15 to 18% of all sites in Arizona are comprised of single, unmated territorial birds.

Permitted activities and stochastic events also continue to adversely affect the distribution and extent of occupied and potential breeding habitat throughout Arizona. The Bureau of Reclamation operation of the new conservation space at Roosevelt Lake could totally inundate the riparian stands occupied by Arizona's largest breeding group (Table 5). As a result of

TABLE 4. RANGEWIDE POPULATION STATUS FOR THE SOUTHWESTERN WILLOW FLYCATCHER (based on composite of 1993-1995 survey data and 1996 survey data from lower Colorado River)[1].

	No. of Sites with Territories	No of. Drainages with Territories	No. of Sites (Drainages)			Total No. of Territories
			with ≤5 Territories	with 6-20 Territories	with >20 Territories	
New Mexico	19	8	16 (6)	2 (0)	1 (2)	173
Arizona	39	9	29 (4)	10 (4)	0 (2)	150
California	18	11	13 (8)	3 (1)	2 (3)	114
Colorado	6	5	6 (5)	0 (0)	0 (0)	13
Utah	2	1	2 (1)	0 (0)	0 (0)	2
Nevada	1	1	1 (1)	0 (0)	0 (0)	2
Texas	?	?	?	?	?	?
Total	85	35	67 (24)	15 (4)	3 (7)	454

[1]Based on surveys conducted at >800 historic and new sites in NM (Maynard, 1995; Cooper, 1996; Skaggs, 1996); AZ (Sogge and Tibbitts, 1992; Sogge *et al.*, 1993; Muiznieks *et al.*, 1994; Sogge and Tibbitts, 1994; Sferra *et al.*, 1995; Sogge, 1995a, Sogge *et al.*, 1995; Spencer *et al.*, 1996, 1997; McKernan, *in litt.*); CA (Camp Pendleton, 1994; Whitfield, 1994; Griffith and Griffith, 1994; Holmgren and Collins, 1995; Kus, 1995; San Diego Natural History Museum, 1995; Whitfield and Strong, 1995; Griffith and Griffith, 1996 *in litt.*); CO (T. Ireland, 1994 *in litt.*; Stransky, 1995); UT (McDonald *et al.*, 1995; Sogge, 1995b); NV (C. Tomlinson, 1995 *in litt.*). Systematic surveys have not been conducted in Texas. For sites surveyed multiple years, highest single-year estimate of territories was used to tabulate status data. Tabulations do not include documented extirpations within survey period. Thus, individual state estimates and rangewide totals may be biased upward.

TABLE 5. AGENCY ACTIONS THAT HAVE UNDERGONE SECTION 7 CONSULTATION AND LEVELS OF INCIDENTAL TAKE PERMITTED FOR THE SOUTHWESTERN WILLOW FLYCATCHER RANGEWIDE

Action	Year	Federal Agency[1]	Incidental Take Anticipated
Arizona			
Eastern Roosevelt Lake Watershed Allotment (Maricopa Co.)	1995*	Tonto NF	Indeterminable
Tonto Creek Riparian Unit (Maricopa Co.)	1995*	Tonto NF	Indeterminable
Cedar Bench Allotment (Yavapai Co.)	1995	Tonto NF	Indeterminable
Tuzigoot Bridge (Yavapai Co.)	1995*	NPS	None
Verde Valley Ranch (Yavapai Co.)	1995*	Corps	Loss of 2 flycatcher territories
Windmill Allotment (Yavapai Co.)	1995	Coconino NF	Loss of 1 flycatcher nest annually
Romero Road Bridge (Pinal Co.)	1995*	FEMA	Consultation in process
Glen Canyon Spike Flow (Coconino Co.)	1996	USBR	Adverse modification of proposed critical habitat
Solomon Bridge (Graham Co.)	1996*	FHWA	Loss of 2 territories
Modified Roosevelt Dam (Gila/Maricopa Co.)	1996*	USBR	Loss of 45 territories; reduced productivity/survivorship 90 birds
U.S. Hwy 93 Wickenburg (Mohave Co.)	1996*	FHWA	Consultation in process
Grazing on 13 Allotments (Pinal Co.)	1996	BLM	Consultation in process
Lower Gila Resource Plan Amend. (Yuma Co.)	1996	BLM	Consultation in process
Lower Colorado River Operations	1996*	USBR	Consultation in process
U.S. Forest Service Region 3 Forest Plans	1996	USFS	Consultation in process
Safford District Grazing Allotments	1996	BLM	Consultation in process
Virgin River Diversion/Fill (Mohave Co.)	1997	EPA	None
California			
Prado Basin, (Riverside/San Bernardino Co.)	1994	Corps	None
Orange County Water District (Orange Co.)	1995	Corps	None
Temescal Wash Bridge (Riverside Co.)	1995	Corps	Harm to 2 flycatchers
Camp Pendleton (San Diego Co.)	1995	DOD	Loss of 4 flycatcher territories

Table 5 (continued).

Action	Year	Federal Agency[1]	Incidental Take Anticipated
Lake Isabella Operations 1996 (Kern Co.)	1996*	Corps	Inundation 700 ac proposed critical habitat; reduced productivity 14 pairs
Lake Isabella Long-Term Operations (Kern Co.)		1997*	CorpsConsultation in process
Nevada			
Gold Properties Resort (Clark Co.)	1995	BIA	Harm to 1 flycatcher from habitat loss
New Mexico			
Corrales Unit, Rio Grande (Bernalillo Co.)	1995	Corps	None
Rio Puerco Resource Area	1996	BLM	Consultation in process
Farmington District Resource Management Plan	1996*		BLMConsultation in process
Mimbres Resource Area Management Plan	1996*	BLM	Consultation in process

[1] BIA = Bureau of Indian Affairs; BLM = Bureau of Land Management; Corps = Army Corps of Engineers; DOD = Dept. of Defense; EPA = Environmental Protection Agency; FEMA = Federal Emergency Management Agency; FHWA = Federal Highway Administration; NF = National Forest; NPS = National Park Service; USBR = U.S. Bureau of Reclamation; USFS = U.S. Forest Service.

* Original proposed action determined to result in jeopardy to the flycatcher and/or adverse modification of proposed critical habitat.

Reclamation's operations on the lower Colorado River, the 445-ha Goodding's willow stand at the inflow to Lake Mead has been partially inundated since September 1995. Despite partial inundation, approximately eight pairs of flycatchers were documented nesting at the inflow during the 1996 breeding season. As of April 1997, however, inundation of that habitat was nearly complete. Reclamation (1996) projected the mortality of that stand sometime during 1997 as a result of prolonged inundation of root crowns (i.e. > two growing seasons).

In June of 1996, a catastrophic fire destroyed approximately one km of occupied habitat on the San Pedro River in Pinal County. That fire resulted in the forced dispersal or loss of up to 8 pairs of flycatchers (Paxton *et al.*, 1996). In June of 1995, approximately three miles of occupied riparian habitat burned on the Gila River in Pinal County (Bureau of Land Management, *in litt.*). It is not known how many flycatchers occupied that location. Approximately two km of riparian habitat burned in Graham County in the vicinity of Safford during 1996. It is not known whether that area was occupied by southwestern willow flycatchers; however, located downstream of an occupied patch that was partially eliminated as a result of the section 7 consultation on the Solomon Bridge (Table 5). The anticipated effects of construction of the Solomon Bridge was dispersal of flycatchers into adjacent habitat. The capability of adjacent habitat to absorb that dispersal was compromised by the fire near Safford.

New Mexico: Unitt (1987) considered New Mexico as the state with the greatest number of extimus remaining. After reviewing the historic status of the flycatcher and its riparian habitat in New Mexico, Hubbard (1987) concluded,

> *[it] is virtually inescapable that a decrease has occurred in the population of breeding willow flycatchers in New Mexico over historic time. This is based on the fact that wooded sloughs and similar habitats have been widely eliminated along streams in New Mexico, largely as a result of the activities of man in the area.*

Unitt (1987), Hubbard (1987), and more recent survey efforts have documented extirpation or virtual extirpation in New Mexico on the San Juan River (San Juan Co.), near Zuni (McKinley Co.), Blue Water Creek (Cibola Co.), Rio Grande (Dona Ana Co. and Socorro Co.). Survey and monitoring efforts since 1993 have documented 173 flycatcher territories on eight drainages (Table 4). Approximately 135 of these territories occur in remnant strips of riparian forest within a 20-mile stretch of the Gila River in Grant Co (Skaggs, 1996). This area contains the largest known breeding group rangewide. Outside of Grant County, however, few flycatchers remain. Statewide, 84% (16) of the 19 sites with flycatchers contain five or fewer territorial birds. Six sites are comprised of single pairs or unmated territorial flycatchers, and six others are comprised of two pairs or two unmated territorial birds.

Texas: The Pecos and Rio Grande rivers in western Texas are considered the easternmost boundary for the southwestern willow flycatcher. Unitt (1987) found specimens from four

locations in Brewster, Hudspeth, and Loving counties where the subspecies is no longer believed to be present. There have been no other recent reports, anecdotal or incidental, of willow flycatcher breeding attempts in the portion of western Texas where E.t. extimus occurred historically. Given that surveys in adjacent Dona Ana County, New Mexico, have failed to document breeding along historically-occupied portions of the Rio Grande, the Service believes it is likely that the southwestern willow flycatcher has been extirpated from Texas.

Colorado: The taxonomic status and the historic distribution and abundance of willow flycatchers in southwestern Colorado remains unclear due to a lack of specimen data and breeding records. Preliminary data on song dialects suggests that the few birds recently documented in southwestern Colorado may be E.t. extimus. These sightings have prompted State and Federal agencies to delineate provisional boundaries for E.t. extimus and sponsor statewide survey efforts. Survey efforts since 1993 have documented a total of six locations in Delta, Mesa, and San Miguel counties where willow flycatchers have been found (Table 4). Two locations have single, unmated males; two locations have single pairs, and the remaining two locations are comprised of four to five territories each.

On March 9, 1997, a fire started by an adjacent landowner burned a 32-ha portion of the Escalante Wildlife Area near Delta, Colorado. That location comprised one of the largest known breeding sites for willow flycatchers in Colorado with approximately seven pairs occupying the site in 1996.

Utah: Specimen data reveal that E.t. extimus historically occurred in southern Utah along the Colorado River, San Juan River, Kanab Creek, Virgin River, and Santa Clara River (Unitt, 1987). The northern boundary of E.t. extimus in south-central Utah remains unclear due to a lack of specimen data from that region. The southwestern willow flycatcher no longer occurs along the Colorado River in Glen Canyon where Lake Powell inundated historically-occupied habitat, nor in downstream unflooded portions of Glen Canyon near Lee's Ferry in Arizona where flycatchers were documented nesting in 1938. Similarly, recent surveys on the Virgin River and tributaries and Kanab Creek have failed to document the presence of flycatchers (McDonald *et al.*, 1995). Single, territorial males and possibly a pair of flycatchers were documented at two locations on the San Juan River (San Juan Co.) in 1995, but breeding was not confirmed (Sogge, 1995b, R.Marshall, pers. obs.). The population totals for Utah are summarized in Table 4.

Nevada: Unitt (1987) documented three locations in Clark County from which E.t. extimus had been collected but not found after 1970. Current survey efforts have documented a single location with two unmated males on the Virgin River in Clark County (Tomlinson, *in litt.*) (Table 4).

Rangewide: Rangewide, the current known population of southwestern willow flycatchers stands at approximately 454 territories (Table 4). These results indicate a critical population status; more than 75% of the locations where flycatchers have been found are comprised of five or fewer territorial birds and up to 20% of the locations are comprised of single, unmated individuals. The distribution of breeding groups is highly fragmented, with groups often separated by considerable distances (e.g., approximately 88 km straight-line distance between breeding flycatchers at Roosevelt Lake, Gila Co., Arizona, and the next closest breeding groups known on either the San Pedro River [Pinal Co.] or Verde River [Yavapai Co.]). Additional survey effort, particularly in southern California, may discover additional small breeding groups. However, rangewide survey efforts have yielded positive results in less than 10% of surveyed locations. Moreover, survey results reveal a consistent pattern rangewide: the southwestern willow flycatcher population as a whole is comprised of extremely small, widely-separated breeding groups or unmated flycatchers.

The data presented in Table 4 represents a composite of surveys conducted since 1992. Locations that had flycatchers for only one year were tabulated as if the location is still extant. Given that extirpation has been documented at several locations during the survey period, this method of analyses introduces a bias that may overestimate the number of breeding groups and overall population size. In addition, females have been documented singing as frequently as males. Because the established survey method relies on singing birds as the entity defining a territory (Tibbitts *et al.,* 1994), double-counting may be another source of sampling error that biases population estimates upward. The figure of 454 southwestern willow flycatcher territories is an approximation based on considerable survey effort, both extensive and intensive. Given sampling errors that may bias population estimates positively or negatively (e.g., incomplete survey effort, double-counting males/females, composite tabulation methodology), natural population fluctuation, and random events, it is likely that the total population of E.t. extimus is fluctuating at between 300 and 500 territories with a substantial proportion of individuals remaining unmated. This figure is alarming because even if all extant sites were fully protected, at such low population levels random demographic, environmental, and genetic events could lead to extirpation of breeding groups and eventually render this species extinct. The high proportion of unmated individuals documented during recent survey efforts suggests the southwestern willow flycatcher may already be subject to a combination of these factors (e.g., uneven sex ratios, low probability of finding mates in a highly fragmented landscape).

Southwestern Willow Flycatcher Reproductive Success - Intensive nest monitoring efforts in California, Arizona, and New Mexico have revealed that: (1) sites with both relatively large and small numbers of pairs have experienced extremely high rates of brood parasitism; (2) high levels of cowbird parasitism in combination with nest loss due to predation have resulted in low reproductive success and, in some cases, population declines; (3) at some sites, levels of cowbird parasitism remain high across years, while at others parasitism varies temporally with cowbirds absent in some years; (4) the probability of a flycatcher successfully fledging its own

young from a nest that has been parasitized by cowbirds is low (i.e., < 5%); (5) cowbird parasitism and/or nest loss due to predation often result in reduced fecundity in subsequent nesting attempts, delayed fledging, and reduced survivorship of late-fledged young, and; (6) nest loss due to predation appears more constant from year to year and across sites, generally in the range of 30 to 50%.

On the South Fork Kern River (Kern Co., California), Whitfield (1993) documented a precipitous decline in the flycatcher breeding population from 1989 to 1993 (44 to 27 pairs). During that same period cowbird parasitism rates between 50 and 80% were also documented (Whitfield, 1993) (Table 6). A cowbird trapping program initiated in 1993 reduced cowbird parasitism rates to < 20%. Flycatcher population numbers appear to have stabilized at 32 to 34 pairs in 1993, 1994, and 1995 (Whitfield, 1994; Whitfield and Strong, 1995). Predation rates have remained relatively constant in the range of 33 to 47% (Table 6). Flycatcher nest success increased from 26% prior to cowbird trapping to 48% after trapping was implemented (Whitfield and Strong, 1995). In addition, the number of young fledged also increased from 1.01 young/pair to 1.73 young/pair during the same period.

Whitfield and Strong (1995) found that, besides lowering nest success, fecundity, and the number of young produced, cowbird parasitism may also lower survivorship of flycatcher young fledged late in the season. Southwestern willow flycatchers that abandon parasitized nests or renest after fledging cowbirds lay fewer eggs in subsequent clutches and, if successful, fledge flycatcher young late in the season. Whitfield and Strong determined that cowbird parasitism delayed successful flycatcher nesting by at least 13 days and this delay resulted in significantly different return rates of juveniles. Only 6.4% of flycatcher young that came from late nests were recaptured in subsequent years, whereas 21.9% of young that came from early nests were recaptured. If these recapture rates mirror actual survivorship, then even though some parasitized flycatchers eventually fledge their own young, nest loss due to parasitism or depredation may have the more insidious effect of reducing overall juvenile survivorship. Despite the cowbird trapping program and increased reproductive success, Whitfield has not observed a population increase at her study area. Whitfield and Strong (1995) speculate that other factors in addition to cowbird parasitism, such as habitat loss and pesticide use on wintering grounds and/or stochastic events such as storms resulting in mortality, may be keeping population numbers low.

The number of unmated, territorial flycatchers and paired flycatchers detected on the Colorado River in the Grand Canyon has remained low since monitoring began in 1982. Brown (1994) reported that at least 50% of flycatcher nests monitored in the Grand Canyon between 1982 and 1987 were parasitized by brown-headed cowbirds. Brown (1994) did not report data on productivity. Given that the probability of successfully fledging a single flycatcher chick is low when a nest is parasitized and the high proportion of nests parasitized during Brown's study, it is likely that flycatcher productivity during that period was also low. In 1992, when

TABLE 6. NEST PREDATION AND BROOD PARASITISM RATES DOCUMENTED FOR THE SOUTHWESTERN WILLOW FLYCATCHER ACROSS ITS RANGE[1].

Location	Pre-1993	1993	1994	1995
S. Fork Kern River (Kern Co., CA)				
% nests parasitized[2]	50 - 80	38*	16*	19*
% nests depredated	33 - 42	37	47	34
San Luis Rey River (San Diego Co. CA)				
% nests parasitized	-	-*	0*	0*
% nests depredated	-	-	28	5
Colorado River (Coconino Co., AZ)				
% nests parasitized	≥50	100	44	100
% nests depredated	-	30	78	0
Verde River (Yavapai Co., AZ)				
% nests parasitized	-	100	50	extirpated
% nests depredated	-	100	50	
Little Colorado River (Apache Co., AZ)				
% nests parasitized	-	-	22	0
% nests depredated	-	-	33	28
Rio Grande (Socorro Co., NM)				
% nests parasitized	-	-	20	66
% nests depredated	-	-	40	60
Gila River (Grant Co., NM)				
% nests parasitized	-	-	-	16 - 27
% nests depredated	-	-	-	45

[1] Sources: Sogge and Tibbitts (1992), Sogge *et al.* (1993), Brown (1994), Maynard (1995), Muiznieks *et al.*(1994), Sogge and Tibbitts (1994), Cooper (1996), Skaggs (1995), Sogge (1995a), Sogge *et al.* (1995), Spencer *et al.* (1996), Whitfield and Strong (1995).

[2] Proportion of nests containing at least one brown-headed cowbird egg.

* Brown-headed cowbird control program implemented.

comprehensive nest monitoring was initiated, two pairs were present, with only one establishing a nest. That nest successfully fledged three flycatchers (Sogge and Tibbitts, 1992). In 1993, one breeding pair, one male with two females, and six unpaired males were detected. Three nests were found, all of which were parasitized by brown-headed cowbirds (Table 6). No flycatchers were successfully reared in Grand Canyon in 1993 (Sogge *et al.*, 1993). Four pairs and one unpaired male occupied Grand Canyon in 1994. Nine nests were attempted, at least four of which were parasitized by cowbirds. All nesting attempts eventually failed due to predation or abandonment (Sogge and Tibbitts, 1994). In 1995, one breeding pair and three unpaired males were detected (Sogge *et al.*, 1995). One nest was found with a single cowbird egg on May 23. On June 4, three flycatcher eggs were present, but the cowbird egg was missing. That nest successfully fledged one flycatcher. In summary, since 1992, 10 known pairs of willow flycatchers have made 14 nesting attempts in the Grand Canyon, two of which successfully fledged a total of four flycatchers. This low rate of reproduction indicates that, even with the protections provided annually by the National Park Service (i.e., camping and other activities are prohibited at flycatcher breeding sites), this area is a population sink (Pulliam, 1988) where reproduction is not adequate to replace adults and population persistence requires emigration from other breeding areas.

On the Verde River in Yavapai County, Arizona, Ohmart (pers. com.) discovered four pairs of flycatchers in 1992 at Clarkdale. The breeding status and reproductive success of those birds was not determined. In 1993, two pairs were present and one nest was documented. The nest contained a single cowbird nestling and eventually failed (Muiznieks *et al.*, 1994) (Table 6). In 1994, two pairs and one unpaired male were present. Two nests were found, one of which successfully fledged two flycatchers, the other fledged a single cowbird (Sferra *et al.*, 1995). Data from a more limited monitoring effort in 1995 indicate that two unpaired males occupied the Clarkdale site (Sogge, 1995a). Surveys during the 1996 breeding season failed to detect any southwestern willow flycatchers at the Clarkdale site. However, one nesting pair of flycatchers was discovered at Tavasci Marsh approximately 2.4 km east of the Clarkdale site. Thus, although since its discovery the Clarkdale site has had only several pairs, cowbird parasitism and nest loss due to depredation resulted in poor reproductive success and may have been responsible for abandonment or extirpation at this site.

Elsewhere in Arizona, population loss or undetected dispersal of breeding groups has been documented since 1993. For example, surveys in 1993 estimated five territorial males at Dudleyville Crossing on the San Pedro River (Pinal Co.). However, surveys in 1994 and 1995 failed to detect any flycatchers at that location (Muiznieks *et al.*, 1994, Sferra *et al.*, 1995, Spencer *et al.*, 1996). Flycatchers detected in 1993 at Soza Wash on the San Pedro River were not detected in followup surveys in 1995, and a flycatcher observed at Ister Flat on the Verde River was not detected in followup surveys during 1994. It is not known whether these events represent mortality of flycatchers, changes in habitat quality, or simply a vagile tendency inherent to this species. At other locations on the San Pedro River in Pinal County, such as

Cook's Lake and PZ Ranch, flycatcher breeding group size has remained stable. However, in 1996 a catastrophic fire destroyed much of the breeding habitat at PZ Ranch resulting in nest loss, abandonment of that site and, perhaps, mortality of adults (Paxton *et al.*, 1996).

On the Little Colorado River in Apache County, Arizona, a cowbird parasitism rate of 22% was documented in 1994 (Table 6). In 1995 the parasitism rate was zero. Nest loss due to depredation, however, remained relatively constant (Table 6). On the Rio Grande in Socorro County, New Mexico, parasitism rates increased from 20% in 1994 to 66% in 1995. In 1996, water was diverted above that breeding location and no flycatchers were present (D.Leal, pers. com.). It is not known whether those birds dispersed elsewhere or if that breeding group was extirpated. Finally, on the Gila River in Grant County, New Mexico, Skaggs (1995) monitored 46 nests from a breeding group of approximately 135 pairs. From a subset of 25 nests whose contents were checked directly or inferred through observation, Skaggs estimated a cowbird parasitism rate of between 16 and 27% for 1995 (Table 6).

The data presented above and in Table 6 demonstrate that cowbird parasitism and nest depredation are affecting southwestern willow flycatchers throughout their range. Cowbirds have been documented at more than 90% of sites surveyed (Sogge and Tibbitts, 1992; Sogge *et al.*, 1993; Camp Pendleton, 1994; Griffith and Griffith, 1994; Muiznieks *et al.*, 1994; Sogge and Tibbitts, 1994; Maynard, 1994; T. Ireland, 1994 *in litt.*, Whitfield 1994; C. Tomlinson, 1995 *in litt.*; Holmgren and Collins, 1995; Kus, 1995; McDonald *et al.*, 1995; Sferra *et al.*, 1995; Sogge, 1995a; Sogge, 1995b; Sogge *et al.*, 1995; San Diego Natural History Museum, 1995; Stransky, 1995; Whitfield and Strong, 1995; Cooper, 1996; Griffith and Griffith, 1996 *in litt.*; Skaggs, 1996; Spencer *et al.*, 1996). Thus, the potential for cowbirds to be a persistent and widespread threat remains high. Cowbird trapping has been demonstrated to be an effective management strategy for increasing reproductive success for the southwestern willow flycatcher as well as for other endangered Passerines (e.g., least Bell's vireo [Vireo bellii pusillus], black-capped vireo [V. atricapillus], golden-cheeked warbler [Dendroica chrysoparia]). It may also benefit juvenile survivorship by increasing the probability that parents fledge birds early in the season. Expansion of cowbird management programs has the potential to not only increase reproductive output and juvenile survivorship at source populations, but also to potentially convert small, sink populations into breeding groups that contribute to population growth and expansion.

Species Description and Status - Peregrine Falcon

The American peregrine falcon was listed as an endangered species on October 13, 1970 (35 FR 16047). No critical habitat has been designated for this species. The peregrine falcon is a medium-sized raptor with various subspecies distributed worldwide. The American peregrine falcon occurs across much of North America. It nests on cliffs near sources of avian prey. The

peregrine falcon has traditionally been strongly associated with cliffs near large bodies of water such as seacoasts, lakes, and large rivers (Ratcliffe, 1980). However, the arid American southwest has recently been demonstrated to support the largest concentration of peregrines known in North America, excluding Alaska. Studies have documented high densities of breeding pairs in the Southwest, particularly the Colorado Plateau Province (Burnham and Enderson, 1987; Hays and Tibbitts, 1989; Tibbitts and Bibles, 1990; Brown, 1991). Local concentrations of nesting pairs have also been documented in the mountains of southeastern Arizona (Tibbitts and Ward, 1990a and 1990b; Berner and Mannan, 1992; Ward 1993).

In the Southwest, breeding peregrines are currently found almost anywhere large (approximately $\geq$100 meter) cliffs are available, with the exception of the hottest and driest desert regions (Tibbitts and Ward, 1990a; Ward, 1993; USDI, unpubl. data). Large cliffs overlooking chaparral, pinyon-juniper woodland, conifer forest, and riparian habitats apparently provide high-quality habitat. These cliffs are currently occupied by breeding pairs almost wherever they occur in Arizona and southern Utah, even where surface water may be many miles distant. In the Sonoran desert, peregrine falcons may be found breeding where perennial surface water and associated riparian prey populations are available. Breeding season for peregrine falcons in the southwest extends from March 1 to late June or early July (Ward and Siemens, 1995).

The American peregrine falcon appears to be making considerable progress toward recovery throughout much of its range. On June 30, 1995, the Service published an advance notice of a proposal to remove the American peregrine falcon from the list of endangered and threatened wildlife, stating that data currently on file with the Service indicate that this subspecies has recovered following restrictions on the use of organochlorine pesticides in the United States and Canada and because of management activities including the reintroduction of captive-bred peregrine falcons (60 FR 34406).

Peregrines feed almost exclusively upon other birds, such as shorebirds, pigeons, doves, robins, flickers, jays, swifts, swallows, and other passerines that opportunity presents (Craig, 1986). Although some individuals may become adept hunters, it is estimated that peregrine succeed in making kills only 10 to 40% of the time (Roalkvam, 1985; Cade, 1982). The falcons compensate for this inefficiency by traveling extensively when hunting. During the breeding season, a hunting range of 10 miles may be considered typical (Craig, 1986). Proximity of a cliff to surface water may affect occupancy. In Arizona, nearly all nest sites which are great distances from extensive permanent water have nearby permanent water sources; rivers, lakes, and streams are the most important sources (Ellis, 1982). The presence of rivers, riparian habitat, or other surface water in peregrine nesting habitat may be a feature in determining the presence of an adequate food supply.

The Peregrine Falcon Recovery Plan for the Southwest Population (USFWS, 1984) recommends against land-use practices and development which adversely alters or eliminates the character of hunting habitat or prey base within 10 miles of an eyrie, and within 1 mile of the nesting cliff.

ENVIRONMENTAL BASELINE

General Environmental Baseline

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

The Blue River is a seriously degraded ecosystem. Aldo Leopold in 1921 called the Blue River "ruined" and cited it as an "extreme example" of human-caused erosion in the Southwest (Leopold, 1921; Leopold, 1946). Human uses of the river and its watershed in combination with natural flood flow events have resulted in extensive changes within the watershed and river channel. The proportional contribution of natural forces and human forces in stream channel erosion in the Southwest over time has been widely discussed (Duce, 1918; Leopold, 1924a; Leopold, 1924b; Bryan, 1925; Leopold, 1946; Hastings, 1959; Hastings and Turner, 1980; Dobyns, 1981; Bahre, 1991). Miller (1961) indicated that as European settlement of the Blue River occurred around 1885 or 1886, the floor of the Blue River canyon was "well sodded and covered with grama grass, hardwoods, and pine," and the banks were "lined with willows and the river abounded with trout" (Leopold, 1921). Olmstead (1919) refers to devastating floods that occurred from 1900 to 1906, which followed and contributed to the loss of floodplain terrains and other major changes to the elevation of the river by 1916. Periodic floods continue to erode remaining fields, homes, and roads (Coor, 1992).

Although the proximate cause of the channel erosion was flooding, the flood destruction was enabled and exacerbated by human activities on the watershed and streambanks (Chamberlain, 1904; Olmstead, 1919; Leopold, 1924; Bryan, 1925; Leopold, 1946; Miller, 1961; Dobyns, 1981; Coor, 1992). Overgrazing depleted herbaceous cover of the watershed and streambanks thus increasing sedimentation, increasing the volume and decreasing the duration of high flows, and decreasing the volume and increasing the duration of low flows. Beaver were eliminated from the river. Timber harvest, fuelwood, and railroad tie cutting removed vegetative cover of the watershed, often resulted in eroding roads and tracks, and damaged the river channel when logs were rafted downstream during high water. Development of fields on river terraces

removed stabilizing riparian vegetation and irrigation canals and headworks destabilized the channel and funneled floodwaters onto terraces causing them to erode. Roads and trails along the river contributed to erosional degradation, often resulting in new channels or widening to the existing channel. Cattle drives along the river broke down streambank soils and damaged riparian vegetation. The resulting stream channel is characterized by a wide shallow channel profile, high levels of sediment, eroding banks, braided shifting channels, and depauperate sparse riparian vegetation (Chamberlain, 1904; Leopold, 1921; Leopold, 1924; Dobyns, 1981; Coor, 1992).

Today, much of the Blue River channel is a wide unvegetated expanse of cobble, gravel, boulder, and sand with a braided and shifting, wide, shallow low-flow channel (Papoulias *et al.*, 1989; Bagley *et al.*, 1995). River terraces or benches are small eroding remnants of former river banks. Riparian vegetation is sparse and lacking in structural diversity. It consists primarily of seep willow (Baccharis salicifolia), and cottonwood (Populus fremontii) seedlings and saplings. Some large cottonwoods and sycamore (Plantanus wrighti) are present, with willow increasingly common in the upper reaches where ponderosa pine (Pinus ponderosa) also enters the riparian corridor. Sedges (Carex sp.), which are a key element in healthy stable streambanks, are uncommon along much of the river.

Limited information or data exists on the fluvial geomorphology of the Blue River, either before the major changes at the turn of the century or after. From brief observations by Service biologists and hydrologists, it appears the river can presently be broadly categorized into several stretches with common characteristics of geomorphology and aquatic and riparian habitat condition. Campbell Blue and Dry Blue Creeks are small streams with relatively stable channels flowing between well defined banks. The valley bottom outside of the low-flow channel has a floodplain of fine alluvial soils which supports moderate amounts of riparian vegetation. Beaver activity is not uncommon. After the confluence of Campbell and Dry Blue Creeks, the Blue River remains in basically the same condition, with erosion, channel width, and channel migration increasing gradually in a downstream direction. Riparian density and aquatic habitat diversity decrease gradually in a downstream direction. Below the Jackson Box the channel widens, lateral migration of the low-water channel increases, floodplain development is less, riparian vegetation becomes less dense, and the aquatic habitat becomes mostly riffles and runs. Beaver activity becomes uncommon. The narrow, bedrock constriction of Jackson Box may act as a geohydrologic control to inhibit upstream migration of lateral and vertical erosion. Another change in the river characteristics occurs near the confluence with Foote Creek. The factors in this change are unknown, but may be related to the input of large drainage tributaries like Foote Creek and Lamphier Canyon. Below this point the low-flow channel migrates across large areas of unvegetated cobble-gravel substrate with remnant terraces in more protected areas. The density of riparian vegetation is substantially less than upstream and the aquatic habitat has little diversity. The Blue Box, like Jackson Box, appears to function as a control to upstream migration of erosion. From the Blue Box downstream to the confluence with the San Francisco

River, the Blue River has little bank or terrace formation and the low-water channel migrates across an unstable gravel/cobble valley bottom. Some mature riparian vegetation exists on remnant benches, but most riparian vegetation is short-lived, dying and arising along the migrating channel. Aquatic habitat is almost monotypic run/riffle with pools scarce and generally associated with bedrock walls.

Information on the hydrology of the Blue River is also limited. Only one U.S. Geological Survey streamflow gauge exists on the Blue River. It is located at the Juan Miller or Stacy crossing (FR475) about 25 miles downstream from the project area. The gauge functioned on a continuous basis from 1969 to 1991, when it was discontinued. It was maintained as a partial-record station, with only maximum annual discharges reported from 1992 to 1995, when it was reinitiated as a continuous record gauge. The records that exist show a bimodal high flow pattern: a snow-melt hydrograph with high flows in late-winter and spring and a second high flow period associated with monsoon rains in later summer. The lowest flows generally occur in early summer. At the gauge, the maximum discharge for the period of record is 30,000 cubic feet per second (cfs) in 1972, minimum discharge is 1.4 cfs in 1978, the median of the yearly mean is 43 cfs, and the 50% exceedance level is 12 cfs (USGS, 1991, 1996). The Blue River is "flashy" with summer storm discharge often an order of magnitude greater than the mean daily discharge on the day of the storm (Gordon *et al.*, 1992; USGS, 1978, 1991, 1996). A Forest Service gauge has been operated since 1959 on Campbell Blue Creek about 6 miles upstream from the project area. The maximum discharge recorded at that gauge was 619 cfs in 1984, the minimum was 0 cfs during several years, and the median of the yearly mean was 2.8 cfs (Colmer, 1992). No discharge data are available for the project area itself, but they would be substantially lower than the USGS gauge data due to the input of large areas of the watershed between the project area and the gauge. Instantaneous discharge data taken by USGS on May 30 to June 26, 1978 is helpful in understanding the general relationship of flow at the USGS gauge to that within the project area (see Table 7). Within the project area, the Blue River has been observed to lose all surface flow in some areas during early summer, most notably near Joy crossing (J. Copeland and C. Denton, pers. com., 1996).

Increased flashiness of flood flows and depletion of base flows are results of reduction of vegetative and soil cover from the watershed, loss of floodplain terraces and soils, and reduction of riparian vegetation (Ffolliott and Throud, 1975; Dunne and Leopold, 1978; DeBano and Schmidt, 1989; Gebhardt *et al.*, 1989; Meehan, 1991; Gordon *et al.*, 1992; Naiman, 1992; Belsky and Blumenthal, 1997). It is likely that these phenomenon are partially responsible for the low base flow that currently exists in the upper Blue River. Coor (1992) reports that local residents recall that there was formerly a more dependable water supply in the Blue River and

TABLE 7. RELATIONSHIP OF DISCHARGE IN PROJECT AREA TO DATA FROM USGS GAUGE (data from USGS, 1978)

Location	Instantaneous Recorded Discharge (cfs)[4]	Discharge as Proportion of Discharge at USGS Gauge	Date	Time
Campbell Blue Ck at USFS gauge	0.10	2%	6/26/78	1640
Campbell Blue Ck at upper end of FR 281	1.0	18%	6/14/78	1100
Campbell Blue Ck at State Line	1.2	22%	6/13/78	0910
Dry Blue Ck at State Line	1.0	18%	6/13/78	1000
Blue River at upper Blue Campground	1.8	33%	6/13/78	1255
Blue River at FR 567	1.4	25%	6/13/78	1615
Blue River below Lamphier Canyon	0.5	9%	6/14/78	1300
Blue River at Blue Box	2.7	50%	6/14/78	1410
Blue River below Tornado Ck 2 miles below lower end of FR 281	1.8	33%	6/14/78	1615
Blue River below Oak Ck	0.37	7%	6/15/78	0930
Blue River below Bull Ck (HU Bar Ranch)	1.9	35%	6/15/78	1130
Blue River at Horse Canyon	3.8	69%	6/15/78	1630
Blue River at USGS gauge	5.5	-	6/16/78	0930
Blue River at mouth	7.1	1.30	5/30/78	1000

[4]Water diversion presently occurs in several places downstream to the end of FR 281. Information is not available on the location or amount of diversions in 1978. Water diversion may account for some of the losses of water in stretches of the Blue River.

that over time many residents have been forced to drill wells to obtain dependable irrigation water. Coor further reports that one resident indicated the following historic conditions:

> *There used to be a lot more water in the Blue than there is now. There was enough water that at one time the miners in Clifton floated their logs down the river to Clifton from the Blue. They cut the logs above the Box and floated them clear to Clifton. Not only was there more water, but it wasn't so rocky. There are a lot more boulders now. There used to be lots more land. Willows grew along the banks, not so many cottonwoods and big trees the way it is now -- just willows. But now it has grown up so thick with big trees you can hardly get through it. It isn't at all the way it used to be. I guess that's what happened to the water. In fact it dries up sometimes in the summer in lots of places. It didn't used to ever, ever do that. We used to have plenty of water in the ditches for our cattle, for our farming, and for everything.*

Present uses of the Blue River watershed and valley bottom continue to contribute to the deteriorated condition of the river, although at a level much reduced from that of the late 1800's. Timber harvest, road, recreation, and grazing activities within the watershed continue to contribute erosion, vegetation change, and alteration of the hydrologic regime. Private lands in the system are concentrated in the upper 30 miles of river bottom. Some cropping and irrigated agriculture continues on remaining river terraces that have natural protection from flood erosion. There are a number of small diversion structures and irrigation canals. A private fish hatchery is operated along the upper Blue River and a substantial proportion of the base flow is diverted into the hatchery. Subdividing of ranch lands and construction of residences or summer homes has occurred at a fairly low level. The road is a continuous source of bank and channel damage and erosion. Numerous low-water ford crossings exist in the upper Blue River contributing to localized destabilization. In the lower Blue, unauthorized off-road-vehicle use in the river bottom continues to occur. Livestock grazing in the valley bottom continues on private lands in the upper Blue. On the Clifton Ranger District, the river corridor is excluded from authorized livestock grazing. Grazing is permitted on Forest Service allotments in the Alpine Ranger District. A recent decision to remove that grazing is currently under administrative appeal (Pers. com.).

Loach Minnow and Razorback Sucker Environmental Baseline and Status in Action Area

For many years, information on the fish of the Blue River was poorly known. Surveys were few and tended to concentrate on the tributary streams (Chamberlain, 1904; Anderson and Turner, 1977; Silvey and Thompson, 1978; J.M.Montgomery Consulting Engineers, 1985; Sheldon and Hendrickson, 1988; Marsh *et al.*, 1989; Papoulias *et al.*, 1989). Anecdotal accounts from area residents recall that the Blue River formerly had "a lot" of fish, but now no longer does (Coor, 1992). Recently, surveys of the Blue River system were conducted by

AGFD in 1994 on the upper Blue River and by Arizona State University during 1995 and 1996, under funding from the Apache-Sitgreaves National Forests, on the lower river and tributaries (AGFD, 1994; Bagley *et al.*, 1995). These surveys found loach minnow distributed throughout the Campbell Blue and Blue River system, but found no razorback sucker. In addition to loach minnow and razorback sucker, the Blue River continues to support four other native fishes, the speckled dace (Rhinichthys osculus), longfin dace (Agosia chrysogaster), desert sucker (Catostomus [Pantosteus] clarki), and Sonora sucker (Catostomus insignis).

The Blue River, like all streams remaining the Gila River basin, has been subject to introduction of a number of nonnative fish and other aquatic species. Although the nonnative species present in the Blue River are relatively fewer than in most Gila basin streams, nonnatives adversely affect the native fish community through competition and predation (Courtenay and Stauffer, 1984; Marsh and Brooks, 1989; Marsh *et al.*, 1989; Propst *et al.*, 1992; Blinn *et al.*, 1993; Carmichael *et al.*, 1993; Douglas *et al.*, 1994). Nonnative species reported in the Blue River during recent survey efforts include rainbow trout (Oncorhynchus mykiss), brown trout (Salmo trutta), fathead minnow (Pimephales promelas), western mosquitofish (Gambusia affinis), and red shiner (Cyprinella lutrensis) (AGFD, 1994; Bagley *et al.*, 1995). Earlier surveys also found channel catfish (Ictalurus punctatus) (Anderson and Turner, 1977; J.M.Montgomery Consulting Engineers, 1985). Local stories say that channel catfish are sometimes quite abundant in the lower Blue River (Stefferud, 1995; B. Csargo, Apache-Sitgreaves National Forests, pers. com., 1996).

Historical records of the Blue River fish fauna and some from the San Francisco and Gila Rivers downstream from the Blue River can be used to construct a list of native fish species that were probably historically found in the Blue River. This information can be combined with early descriptions of the river and its valley bottom, from which it appears that the river was much narrower with more distinct streambanks and floodplain and a wider, denser riparian cover and that the aquatic habitat was much more varied and complex. From this information the Service concludes that up to nine species, or 65% of the native fish species, have been extirpated from the Blue River in the past century. Reintroduction of one of those, the razorback sucker, has been attempted with uncertain success. Of the four remaining native species, loach minnow is the rarest.

The loach minnow was first documented from the Blue River in 1977 (Anderson and Turner, 1977). The only earlier fish survey was in 1904 (Chamberlain) which did not find loach minnow. Several efforts since then have located loach minnow distributed in suitable habitat from the middle reaches of Campbell Blue Creek downstream to the confluence with the Blue River (Silvey and Thompson, 1978; J.M.Montgomery Consulting Engineers, 1985; Hendrickson, 1987; Sheldon and Hendrickson, 1988; Marsh *et al.*, 1989; Papoulias *et al.*, 1989; AGFD, 1994; Bagley *et al.*, 1995). Loach minnow were not found in any tributaries other than Campbell Blue Creek and in KP Creek just above its confluence with the Blue River. Recent

surveys have found loach minnow to be relatively common, although it is not present at all sites and is the least abundant of the five native species (AGFD, 1994; Bagley *et al.*, 1995).

Although no historic records of razorback sucker exist from the Blue River, the 1887 type locality for the species is the Gila River at Fort Thomas and local residents reported that razorback sucker was common in the Gila River near Safford and Duncan in the early 1900's (Kirsch, 1888; Chamberlain, 1904). Due to habitat alterations and losses, and introduction and spread of non-native species, the razorback sucker was extirpated from the Gila River and all of its tributaries, including the Blue River, when Chamberlain documented a depleted fish fauna in 1904. Because of their historic presence in the nearby Gila River and the presence of apparently suitable habitat, the Blue River is presumed by species experts to have historically supported razorback sucker. Due to habitat alterations and losses and introduction and spread of nonnative species, the razorback sucker was extirpated from the Gila River and all of its tributaries. Between 1986 and 1989, razorback sucker was reintroduced into the Blue River using hatchery stock originating from Lake Mohave via Dexter National Fish Hatchery (Hendrickson, 1993). Stocking occurred at several places throughout most of the length of the Blue River. These stockings were made prior to listing of the razorback sucker and when the species was listed in 1991, equal protection was given to stocked and natural populations. Few recaptures of stocked razorbacks have occurred, due at least partly to infrequent and scattered sampling. Recaptures are limited to one at Juan Miller Crossing in 1986 and two at the Blue Box in 1987. No razorback sucker were found during recent surveys of the Blue River by AGFD, Arizona State University, and the Apache-Sitgreaves National Forests (AGFD, 1994; Bagley *et al.*, 1995). The Blue River is considered to be occupied by razorback sucker, although whether or not a self-sustaining population has been established is not known.

Bald Eagle Environmental Baseline and Status in Action Area

No bald eagle nests are known to exist on the Blue River. The nearest nest site is at Luna Lake, approximately 20 air miles from the proposed project. Studies conducted through the Bald Eagle Nestwatch program in 1997 have determined that the eagles occupying the Luna Lake breeding area leave the lake to forage. It is possible that the eagles are foraging at either Nelson Reservoir or the Blue River. While the breeding area is located approximately 20 miles from those portions of the Blue River affected by this project, travel of this distance for foraging is not unprecedented (Beatty, AGFD pers. com. 1997). Additionally, wintering bald eagles frequently use the area and surveys are conducted each winter by Forest Service and AGFD personnel in this area. In the winter of 1996, three adult bald eagles were found along the upper Blue River in twelve minutes of helicopter surveying (Beatty and Driscoll, 1996). It is also possible that bald eagles from the Luna Lake breeding area use the Blue River for wintering habitat should Luna Lake freeze over (Beatty, AFGD, pers. com. 1997). Habitat requirements for wintering bald eagles are less critical compared to nesting habitat requirements. Primary

management emphasis for wintering bald eagles includes protecting foraging areas, daytime perching areas, and night roosts. Generally, the Service recommends developing a buffer zone of one-quarter mile around any known foraging areas, with human traffic restricted in this area between October 1 and April 15. Siltation caused by projects such as logging, overgrazing, or road building may adversely affect bald eagle prey species and should be avoided. Similar protection should be established for daytime perch areas. These areas are usually near their foraging areas, and large trees or snags are favored. Activities that have the potential to impede foraging include livestock grazing, dumping of dredge spoils, or activities associated with high noise. Night roosts are generally used only at night but may be used during inclement weather. These areas tend to provide protection from harsh weather, and consist of large trees in areas sheltered from the weather by other trees or topographic features. The Service recommends developing buffer zones of one-quarter mile around known night roosts, and the exclusion or limitation of human activity in these areas between October 1 and April 15. Logging, road developing, or other practices that would involve removal of trees may adversely affect night roosts by removing vegetation that serves as wind breaks for night roosts (Martell, 1992). Large trees, either living or dead, are the most common perch sites, preferably near foraging areas (Grubb and Kennedy, 1982). Food is primarily fish, but may also include birds and small mammals. In northern Arizona, wintering bald eagles primarily forage on waterfowl and carrion (Hunt *et al.*, 1992).

Southwestern Willow Flycatcher Environmental Baseline and Status in Action Area

No southwestern willow flycatchers are presently known from the Blue River but only limited surveys have been conducted. The only surveys that have been conducted on the upper Blue River were in 1994 by AGFD and no southwestern willow flycatchers were found (Sferra *et al.*, 1995). However, in 1993-95 southwestern willow flycatchers were found in the San Francisco River at Alpine approximately 8 air miles north of the project area, near Greer and Nelson Reservoir in the Little Colorado River drainage approximately 25-30 air miles northwest of the project area, and at Thompson Ranch on the Black River approximately 15 air miles west of the project area (Muiznieks *et al.*, 1994, Sferra *et al.*, 1995, Spencer *et al.*, 1996). There is one reference to an auditory response in 1989 along the Blue River within the project area (see BA).

As noted in the BA, the habitat presently existing along the upper Blue River is not suitable for nesting of southwestern willow flycatcher because of reduced structure and density. Erosion and related impacts associated with Forest Road 281 and its maintenance contribute in part to habitat degradation. If the proposed action alleviates some of the adverse impacts and allows for some regeneration and restoration of the riparian vegetation, there is a potential for occupation of the upper Blue River by nesting southwestern willow flycatchers. The Service believes that this potential is greatest at the upper end and along Campbell Blue Creek where riparian vegetation

still maintains a moderate density and condition. This is also the area closest to the existing known birds at Alpine and the Black River.

Peregrine Falcon Environmental Baseline and Status in the Action Area

Recovery of the peregrine falcon in the Rocky Mountain/Southwest region appears to be greatest in the Colorado Plateau of southern Utah, southwest Colorado, and northern Arizona, and in adjacent habitats in Arizona, Utah and Colorado. This region has experienced high total numbers of breeding pairs, high rates of site occupancy and high reproductive success (Burnham and Enderson, 1987; Tibbitts and Bibles, 1990; Tibbitts and Ward, 1990a and 1990b; Enderson *et al.*, 1991; Ward 1993). Based on 1994 surveys, the current Rocky Mountain/Southwest population consists of 559 breeding pairs, surpassing the recovery objective by 376 pairs (FR 60:34406-34409).

Productivity at breeding areas in the Intermontane Province, where the proposed project is located, between 1992 and 1995 had the lowest percent occupancy rate, at 78%. However, productivity was relatively high at 1.1 young fledged per occupied site (Garrison and Spencer, 1996).

Three active peregrine falcon eyries are known to occur within 1 1/2 to 6 miles from the river and road. No peregrine falcons, breeding or otherwise, have been observed in the project area. There are suitable cliffs along the river and road. No surveys for peregrine falcon, either informally or with established protocols, have been conducted. Therefore, there is a potential that breeding peregrine falcons may occur in the action area. Although there are many rocky outcrops and cliffs in the project area, most are low and small and not suitable for nesting peregrine falcons. It is roughly estimated that a total of 16 miles of potential peregrine nesting habitat occurs within one-half mile of the roads where work would occur. The 16 miles are found at 95 different sites spread out across the entire project area. The 95 sites are fairly evenly distributed within the project area and are composed of vertical cliffs over 100 feet tall (J. Copeland, Apache-Sitgreaves Nat. Forests, pers. com., April-May 1997).

Section 7 Consultation Environmental Baseline in the Action Area

Four formal consultation and seven informal concurrences with findings "is not likely to adversely affect" have been previously completed on effects of Federal actions on the loach minnow, razorback sucker, bald eagle, southwestern willow flycatcher, and/or peregrine falcon in the Blue River basin. These are summarized in Table 8.

TABLE 8. SECTION 7 CONSULTATIONS IN ACTION AREA			
Project	Date of Opinion or Concurrence	Species[5]	Finding
FORMAL CONSULTATIONS			
Apache-Sitgreaves NF Land and Resources Management Plan	May 1986	loach minnow[6] bald eagle peregrine falcon razorback sucker[7] SW willow flycatcher[7]	net benefit nonjeopardy nonjeopardy none none
Campbell and Isabelle Timber Sales	May 1993	loach minnow & critical habitat	nonjeopardy no adverse modification
Maintenance and repair of FR 475 low-water crossing	April 1995	loach minnow & critical habitat	nonjeopardy no adverse modification
Navopache Power powerline rerouting	March 1997	loach minnow razorback sucker bald eagle	nonjeopardy nonjeopardy nonjeopardy
INFORMAL CONSULTATIONS - IS NOT LIKELY TO ADVERSELY AFFECT CONCURRENCES			
Repair of certain sites on FR 281	February 1996	loach minnow	concurrence
Repair of road crossing on Highway 191	August 1996	loach minnow	concurrence

[5]Only species also in this biological opinion are included here.

[6]Proposed at time of consultation.

[7]Not listed at time of consultation.

Programmatic for Forest Service grazing permits[8] McCarty, Drachman, Wiltbank & Wiltbank, Heap, Lazy YJ, Downs, Coleman & Robart, ELC, & Voit/Rudd allotments	May 1995 (FWS programmatic concurrence) 1995/6 Forest Service use of programmatic concurrence on these allotments	loach minnow razorback sucker bald eagle SW willow flycatcher peregrine falcon	programmatic concurrence without site-specific Service involvement
East Castle prescribed burn	February 1997	loach minnow bald eagle peregrine falcon	concurrence concurrence concurrence
McKibben prescribed burn	February 1997	loach minnow bald eagle peregrine falcon	concurrence concurrence concurrence
KP trail reconstruction	February 1997	loach minnow razorback sucker	concurrence concurrence
Little Timber Sale	February 1997	loach minnow bald eagle peregrine falcon	concurrence concurrence concurrence
Tutt Creek Trailhead	May 2, 1997	loach minnow bald eagle peregrine falcon	concurrence concurrence concurrence

DIRECT AND INDIRECT EFFECTS OF THE ACTION

Because of the deteriorated state of the Blue River, accumulating effects of all impacts are of concern. A significant proportion of the adverse impacts to the Blue River and its aquatic and riparian ecosystem come from small actions that do not individually threaten the system, but cumulatively result in deterioration of the ecosystem. In addition to these small, accumulative impacts there are also some activities with larger impacts. Addressing these larger-impact activities is necessary because there is a potential for greater benefit from a smaller input of effort and the larger activities are also part of the accumulative aspect of the overall threats to the Blue River ecosystem and the listed species it supports.

[8]This was the *Non Site-Specific Biological Assessment for Threatened, Endangered, and Proposed Species on more than one Forest*, April 7, 1995.

The effects of the proposed action result from five categories of road actions:

1. effects of the maintenance and repair of County-maintained floodplain roads under the six emergency consultations;

2. effects of normal maintenance and repair of County-maintained floodplain roads using the BMPs during the 12-month interim period;

3. effects of the use of the road within the floodplain during the 12-month interim period;

4. effects of the continued existence of the roads within the floodplain during the 12-month interim period; and

5. effects of the existence, use, maintenance and repair of County-maintained roads within the drainage but not in the floodplain during the 12-month interim period.

The specific subjects of this consultation are finalization of emergency consultations and adoption of BMPs for normal maintenance and repair of the roads during the 12-month interim period. However, those actions have no independent utility apart from the existence and use of the roads, as they would not have occurred if the roads did not exist or if they were not used. Therefore, the overall analysis considers the effects of all five categories of road actions.

The effects of maintenance and repair activities performed under the six emergency consultations are similar in kind to those under the BMPs. However, the level of adverse effects should be of a lower level for work under the BMPs due to the incorporated protective standards. The BMPs are a valuable tool in reducing the future and ongoing damage to the Blue River and its aquatic and riparian ecosystem from the existence, use, maintenance, and repair of the roads along the upper Blue River. The BMPs would also help remove or alleviate some portion of the damage that has occurred in the past due to maintenance and repair activities, although the proportion cannot be quantified due to lack of documentation of the effects or extent of past maintenance and repair activities. However, even with use of the BMPs, there would still be adverse effects to the river and its ecosystems from maintenance and repair of the road. The types of actions that would occur under the BMPs and the effects to the aquatic and riparian habitats are shown in Tables 9 and 10.

The effects from the existence, use, maintenance and repair of the non-floodplain roads are more limited than those from the floodplain roads. The primary adverse effects of these roads are as contributors to the overall erosion and sediment production of the watershed. These effects are difficult to quantify, based on the BA and other supporting information. The accumulative aspect of watershed degradation is an important factor in the protection and recovery of the

TABLE 9. BLUE RIVER ROAD BEST MANAGEMENT PRACTICES - TYPES OF ACTIONS EXPECTED UNDER EACH ACTION ITEM

TYPE OF ACTION	ACTION 1	ACTION 2	ACTION 3	ACTION 4	ACTION 5	ACTION 6	ACTION 7	ACTION 8	ACTION 9
using heavy equipment in stream/channel/floodplain	X	X	X		X	X	X	X	
dredging stream/channel bottom	X	X					X		
filling stream/channel bottom	X	X	X				X		
breaking down and contouring banks	X	X	X			X			
widening and shallowing stream	X	X							
removing riparian vegetation	X	X	X				X		X
removing woody debris from stream/channel/floodplain	X	X	X				X		
excavating stream channel/ banks/floodplain for fill	X	X				X			
disposing of excess material	X	X			X				
compacting substrate and banks	X	X							
storing materials and equipment	X	X	X	X		X		X	
diverting flow	X		X		X	X	X	X	

► *Blue River Roads, Emergencies and BMPs, Interim Biological Opinion - June 16, 1997* ◄

TYPE OF ACTION	ACTION 1	ACTION 2	ACTION 3	ACTION 4	ACTION 5	ACTION 6	ACTION 7	ACTION 8	ACTION 9
hardening/compacting streambanks, or installing riprap/gabions/soil cement			X		X		X		
modifying channel cross section	X	X	X					X	
diking in floodplain			X					X	
staging			X		X		X	X	
putting pilings/structures in channel			X						
spreading gravel/surfacing material on roadbed				x					
excavating gravel from stream/ channel/floodplain	X	X		X	X	X	X		
hauling materials on road/stream crossing			X	X	X	X			
removing slide material									
compacting hillsides					X				
installing upland riprap, benching, mulching					X				
blasting					X				
recontouring excavated area						X			

TYPE OF ACTION	ACTION 1	ACTION 2	ACTION 3	ACTION 4	ACTION 5	ACTION 6	ACTION 7	ACTION 8	ACTION 9
constructing new roadbed					X		X		
removing snow									X
grading road									X
putting in signs									X
putting in gates/fences/cattleguards									X
removing upland vegetation					X				X

TABLE 10. BLUE RIVER ROAD BEST MANAGEMENT PRACTICES - TYPES OF EFFECTS EXPECTED UNDER EACH ACTION ITEM

TYPE OF EFFECT	ACTION 1	ACTION 2	ACTION 3	ACTION 4	ACTION 5	ACTION 6	ACTION 7	ACTION 8	ACTION 9
sedimentation during construction	X	X	X	X	X	X	X	X	X
sedimentation during road use/or in long-term	X	X				X	X		
pollution during construction	X	X	X	X	X	X	X	X	X
pollution during use/or in long-term	X	X							
bank erosion during construction	X	X	X		X	X	X	X	X
bank erosion during use	X	X	X			X	X	X	X
alteration of channel morphology/instream habitat during construction	X	X	X			X	X	X	
alteration of channel morphology/instream habitat in long-term	X	X	X			X	X	X	
alteration of channel morphology/floodplain function during construction	X	X	X			X	X	X	

► *Blue River Roads, Emergencies and BMPs, Interim Biological Opinion - June 16, 1997* ◄

TYPE OF EFFECT	ACTION 1	ACTION 2	ACTION 3	ACTION 4	ACTION 5	ACTION 6	ACTION 7	ACTION 8	ACTION 9
alteration of channel morphology/floodplain function in long-tern	X	X	X			X	X	X	
direct take (killing) of fish/eggs during construction	X	X	X			X	X	X	
direct take (killing) of fish/eggs during use	X	X				X		X	
expansion of borrow area over time	X	X					X	X	
deposition of excess material	X	X		X	X		X	X	
loss of riparian vegetation	X	X	X		X	X	X	X	X
restriction/constriction of channel			X				X	X	
movement of road material during flood events				X			X		
sidecasting					X		X		X
increase in raw/unvegetated uplands/slopes		X			X	X	X		
development of additional vehicle tracks						X			
substrate compaction	X	X						X	
compacting hillsides					X		X		

TYPE OF EFFECT	ACTION 1	ACTION 2	ACTION 3	ACTION 4	ACTION 5	ACTION 6	ACTION 7	ACTION 8	ACTION 9
increases instability and disfunction in channel	X	X	X		X	X	X	X	
noise and activity with possible raptor disturbance	X	X	X	X	X	X	X	X	X

upper Blue River ecosystem and its listed species, and we believe that it is important to apply measures to alleviate those effects, such as the proposed BMPs.

The effects to listed species and aquatic and riparian ecosystem from roads in the Blue River drainage have a strong temporal aspect, as does the formulation and implementation of long-term solutions. The effects are ongoing, accumulative over time, and many are synergistic in nature. Some effects are irreversible, while others are not. Therefore, although the nature of the effects will remain the same in the 12-month interim period as in the long-term, the level will be decreased due to the short time frame. The interim approach is designed to provide for formulation of a more comprehensive plan for developing and implementing long-term solutions to road impacts. Adverse impacts from road existence, use, repair, and maintenance during the interim period are expected to be compensated for in the long-term by the benefits of implementation of a long-term solution.

Effects to River Channel, Floodplain, and Riparian Vegetation

Effects to four of the five species considered in this opinion (loach minnow, razorback sucker, bald eagle, and southwestern willow flycatcher) are tied to the effects of road existence, use, maintenance, and repair on the river channel, floodplain, and riparian vegetation. Although most of the effects to peregrine falcon are independent of the river channel and floodplain, the falcon's prey base may be affected, with resulting impacts to the falcon.

The adverse effects of roads on streams have been documented. Roads and their construction and maintenance cause sediment input into streams, contribute to bank and channel instability and erosion, remove or reduce riparian vegetation, constrict channels, and compact bank soils and stream substrates (Dobyns, 1981; Brozka, 1982; Faber *et al.*, 1989; Patten, 1989; Meehan, 1991; Naiman, 1992; Young, 1994; Waters, 1995). Construction and protection of roads are among the leading causes of stream channelization (Benson and Weithman, 1980; Simpson *et al.*, 1982). In addition, many indirect adverse effects are attributable to roads along streams, including increased pollution, increased recreational use, increased suburban development, increasing channelization, and increased removal of large woody debris.

The most serious and long-term adverse effect is the contribution of the road and its repair and maintenance to disruption of the natural function of the river channel. The historic road on the floodplain of the Blue River has been indicated as one of the major factors in the erosion and destabilization of the river (Leopold, 1946). The Blue River was cited by Dobyns (1981) as a case study for the role of valley bottom roads in the erosion of river channels. At the time of settlement by Europeans, the farms and ranches along the Blue River were accessed by a road running from Clifton up the bottom of the San Francisco River, then turning up the Blue and

running along its valley bottom to the headwaters where it ascended the divide to reach the towns of Alpine and Luna (Coor 1992).

With continued use, the crossings began to erode and on the terraces the road funneled floodwaters in new directions, thus widening the low-water channel and narrowing the terraces. This resulted in continued rerouting of the road outward toward the canyon walls in search of more stable terraces. In combination with other impacts to the watershed and floodplain, the road continued to erode the terraces. By 1904, the valley bottom erosion was so advanced that the road was impassable to wagons from near the present Juan Miller (Stacy) crossing of FR475 upstream to near the present downstream end of FR281 (Coor, 1992). By 1922 there were few terraces left along much of the river, and major portions of the road were impassable (Leopold 1946).

The present road represents only about half the length of the original road. The road from Clifton up the San Francisco has been rebuilt along the hillside for several miles and then becomes a high-clearance track along the cobble floodplain of the San Francisco River for nine miles. From there the road is closed to vehicle use and impassable for normal vehicles for 5 miles to the mouth of the Blue River and for the lower 25 miles of the Blue River. About 5 miles of the 30 miles of FR 281 along the upper Blue River have been rerouted up onto hillside benches away from the floodplain. In the remaining 25 miles, there are many areas where the roadbed has been constructed in the hillside at the edge of the floodplain or built on fill placed at the toe of the canyon wall to replace the eroded terrace. In other areas, remnant terraces continue to be reinforced with riprap, gabions, and other methods to slow or prevent their erosion. At some points the roadbed is built up of riverbed and floodplain materials scraped into a raised "causeway" that crosses portions of the floodplain where there is no terrace left to hold the road and the hillside is too steep or rugged to allow rerouting of the road. Frequent maintenance and repair is needed to prevent the road from being eroded away by the river which frequently changes channels on the floodplain (D. Miller, B. Marks, and R. Stokes, Greenlee County, pers. com).

The road within the Blue River floodplain causes a variety of alterations to the natural channel geometry. Each river has a channel that has been formed over time by the discharge, sediment, slope, roughness, bank composition and other factors to possess a distinctive geometry that includes the sinuosity, depth, width, velocity, meander length, pool-riffle sequence, and other characteristics that allow the river to function within a range of conditions referred to as a dynamic equilibrium (Leopold *et al.*, 1964; Gordon *et al.*, 1992; Leopold, 1994). Within this dynamic equilibrium, the various channel-forming factors are in balance. Changes that alter the dynamic equilibrium result in "instability" that causes the river to seek a new balance with resultant changes in channel form and function. Depending upon the magnitude of the changes, establishment of a new equilibrium may take several years or several decades and may never occur as long as the changes are ongoing. Over the past century, the Blue River roads have

contributed to alterations of the Blue River channel which have triggered the natural response of the river to seek to reestablish a dynamic equilibrium similar to the pre-disturbance condition (Dunne and Leopold, 1978). This reestablishment process leads to erosion of the roadbed where it restricts the stream's natural pattern. Road erosion leads to further road maintenance and repair activities and stream channelization, thus further altering the stream channel. This iterative process began on the Blue River over a hundred years ago and continues with the ongoing maintenance and repair activities under consultation here. Road construction, repair, and maintenance have cut off channel meanders and/or changed meander wave lengths. Cutting off channel meanders shortens the stream. Altering meander patterns increases or decreases gradient, thus increasing or decreasing velocity and altering patterns of sediment deposition or removal. Altered sediment patterns and volumes changes riffle-pool sequences thus altering regulation of stream energy. Use, repair and maintenance of low-water crossings widens the channel thus reducing velocities and causing sediment deposition. Bridges and "causeways" constrict the channel thus increasing velocities and causing degradation of the channel. These are all common adverse effects of road construction in river corridors (Heede, 1980).

The road and its maintenance and repair increases sediment input into the river. Road construction and maintenance are a recognized source of large amounts of sediment (Waters, 1995). Sediment production results from a number of road characteristics and activities including the removal of riparian vegetation during construction activities, the increased amount of bare soil exposed on the roadbed, the channel cutting that occurs as the river tries to find a new equilibrium, the repeated disturbance of the channel to rebuild or armor the roadbed, and the gravel mining activities in the floodplain. In addition to direct detrimental effects on aquatic fauna, excessive sediment contributes to alteration of the channel through filling of pools, creations of braided channels, increased scouring, and changes in substrate. Oldfield (1996) concludes that the contribution of the road to the overall sediment load of the Blue River is "insignificant" in relation to the "natural" sediment being fed into the river by runoff from the watershed. This is based on his estimate that the total volume of the roadbed along approximately a third of the total road length is only about 25% of the volume of sediment he estimates enters the Blue River per mile via tributaries. While Oldfield's estimates indicate that erosion of the roadbed is only a small portion of the sediment input into the Blue River, his estimates do not include the sediment contribution from the bank erosion caused by disruption of the channel geometry and the removal or suppression of the riparian vegetation. In a system such as the Blue River, where the natural sediment production of the watershed is high (Oldfield, 1996) and has been augmented by a century of watershed use and erosion, additions of sediment, such as the road, are of concern for listed species dependent on the system. The Service believes that the future of the Blue River riparian and aquatic fauna depends upon reduction of all sources of sediment to a more natural condition.

Repeated disruption or removal of riparian vegetation regrowth from the river channel along the road prevents the riparian vegetation from regenerating to a state where it can stabilize and

rebuild the stream channel. This suppression of riparian vegetation impairs its ability to provide buffering, soil stabilization, and bank building. In addition, nutrient-cycling is disrupted thus further damaging the health of the riparian zone (Green and Kauffman, 1989). The existence of the road within the floodplain and the disruption of riparian vegetation during maintenance restricts the ability of the riparian vegetation to act as a buffer to the stream. A healthy riparian zone with substantial herbaceous cover is a very effective buffer for filtering sediment and pollutants from projects before they can reach the stream (Erman *et al.*, 1977; Mahoney and Erman, 1981; Lowrance *et al.*, 1984; Bisson *et al.*, 1992; Osborne and Kovacic, 1993). The riparian vegetation also serves to reduce streambank erosion (U.S. Forest Service, 1977; Thomas *et al.*, 1979; Heede, 1985; Stromberg, 1993). On much of the Blue River, the riparian vegetation is sparse and mostly lacking in herbaceous cover (see BA). Therefore, the opportunity for riparian buffering of road effects is low. In addition, the road is often inside of the riparian zone and actually within the stream on crossings, thus preventing even the limited buffering capability of riparian vegetation from working. Without sufficient riparian vegetation development and buffering capability, the streambanks cannot capture fine sediment and cannot maintain or reestablish the floodplain soils (Clifton, 1989). The fine sediment that is not captured by the impaired riparian vegetation enters the river and becomes excess sediment on the river substrate.

Large woody debris is an important component of the riparian and aquatic ecosystem (Benke *et al.*, 1985; Minckley and Rinne, 1985; Wilzback, 1989). The existence, maintenance, and repair of the Blue River road decreases the large woody debris in the Blue River. The aquatic habitat of the Blue River is lacking in large woody debris which contributes to the lack of habitat diversity (FWS, unpub. data). The most direct mechanism is the removal of large woody debris, such as logs, rootwads, and debris jams during road maintenance. This is done to prevent the debris from directing river current in ways that erode or otherwise threaten the road and its bridges and crossings. A less direct effect, is the loss of the source of large woody debris as the riparian vegetation is destroyed or suppressed by the road itself or by the alterations of the river channel and floodplain as a result of the road.

Mining of gravel from within the floodplain has substantial adverse effects on the river channel and riparian zone. Gravel mining is a common practice in floodplains and has been practiced along the Blue River for over a century. There are various types of gravel mining; the type presently practiced and proposed in the BMPs is referred to as "bar skimming" or "bar scalping." Bar skimming consists of scraping off the top layer of floodplain gravel bars without excavating below the water level (Kondolf, 1994). Bar skimming is probably the gravel mining technique with the least adverse effects to the stream channel. However, adverse effects still occur, the level of which may vary substantially depending upon characteristics of the watershed and channel. Unfortunately, the type of information needed to accurately predict the effects of the bar skimming proposed for the Blue River is not available in the BA or supporting information. Information needed includes the rate of replenishment of sediments within the

system, the pattern of replenishment and loss, the existing status of the bed elevation and its trend (aggrading, degrading, or stable), the existing bed particle size distribution, the historic and existing channel geometry pattern, as well as other basic information on the hydrology, geology, and geomorphology of the upper Blue River and its watershed (Collins and Dunne, 1990; Kondolf, 1994).

The effects of gravel mining are difficult to distinguish from those of other actions within the watershed that also affect the river (Kondolf, 1994). In addition, the effects may not be realized for several years and may occur as a gradual change over time or as a catastrophic change during a major flood event (Sandecki, 1989). Gravel bar skimming removes sediment from the system. If the amount removed does not exceed the replenishment rate, the removal is only temporary. How temporary is unknown and may be highly variable (Kondolf, 1994). In a system like the Blue River with a highly variable pattern and volume of flooding, the removal may be replenished immediately or not for several years. The proposed BMPs would restrict gravel mining to specified sites within the 2.5 to 10 year floodplain. This means that on the average, the entire area mined would be flooded once every 10 years, thus replenishing the sediments. The lower on the floodplain the skimming occurs, the shorter the period of time expected to replenish the gravel removed, with the lowest areas flooded, and presumably replenished, within 2.5 years. However, flood reoccurrence intervals are averages and the flooding, and presumed replenishment, may occur immediately or may take longer than 10 years.

Gravel bar skimming can have profound impacts to channel morphology and aquatic habitats even at low volumes of extraction (Kondolf, 1994). Bar skimming produces a wide flat cross section in the river channel, creating shallower water, slower velocities, and a less diverse aquatic habitat. It removes the substrate pavement thus exposing finer sediments which become entrained in the current and move downstream. The likelihood of loss of surface flow increases due to the wider, shallower cross section, pavement removal, and the creation of coarser, loosely consolidated substrate. Although bar skimming is less likely to cause downstream or upstream channel degradation than other methods of gravel extraction, some degradation may occur particularly in a downstream direction, as the supply of sediment to downstream areas is intercepted by the mined area (Collins and Dunne, 1990).

The gravel mining proposed in this project would be of relatively small amounts. If these amounts do not exceed the replenishment rate of sediment for the Blue River system, the effects would be temporary. However, the BMPs are not clear as to the interval required between use of any specific gravel mining location. It appears that the BMPs allow reentry immediately following replenishment. Under this scenario, the disturbance and adverse effects may not be temporary, because disturbance may reoccur as soon as recovery is underway.

Sites identified sites for gravel mining include overflow channels, abandoned river channels, side bars, tributary fans, point bars, and sediments stored behind culverts, low-water crossings, and grade control structures. One identified site is a moderate-sized dike constructed on an outside bend of the river to protect the road from flooding. In general, these sites were selected because gravel removal has a lower probability there than at other sites of affecting the existing low-water channel or the long-term channel morphology. Harvesting of sediments which have accumulated due to human-built structures, such as culverts, grade control structures, and low water crossings may have limited impact. Upstream effects on the tributary fan site will be prevented by the presence of an existing grade-control structure upstream from the site. Removal of the dike and use of it for road materials will restore part of the floodplain to the river and is expected to have overall beneficial effects, given that care will be taken to avoid damaging or removing riparian vegetation regeneration in the area behind the dike.

Although from the viewpoint of maintaining the overall character of the river channel, point bars are the least damaging location for gravel extraction (Woodward-Clyde Consultants, 1976; Sandecki, 1989), from the viewpoint of long-term health of the aquatic and riparian ecosystems of the Blue River, mining of point bars may be undesirable. The point bar is the depositional area on the inside of a meander bend. Deposition of material onto the point bar and the subsequent outward migration of the outside bank are the process by which floodplains are built (Leopold *et al.*, 1964). Long-term maintenance of the Blue River ecosystem may require that we do more than maintain the status quo of the floodplain. It may require restoring the system to the point where the river is rebuilding fine-soiled banks and terraces, providing the habitat for dense riparian vegetation and the fauna it supports, and narrowing the base-flow channel with steeply sloping or overhanging banks. Use of point bars as gravel sources may inhibit that process.

Operation of heavy machinery on gravel bars and in the riparian zone would occur during gravel mining operations. The BMPs provide that no gravel would be mined from areas across the watered channel from the road except during emergency situations to restore access. This would minimize the adverse effects that would occur from operation of heavy machinery in the aquatic habitat. How often "emergency" situations would occur is not clear, but based on the experience during this consultation it may vary from none to at least half a dozen in any given year. Stockpiling of gravel should lessen the need for these emergency episodes of gravel mining from areas on the non-road side of the river, but stockpiled gravel may not be available during emergency situations due to road washouts or deep water on low-water crossings.

During normal gravel mining operations access ramps and paths for the machinery would be needed. These ramps and roads would require removal of some riparian vegetation and would result in compacted areas of soil. The ramps could also result in increased vehicular use.

The BMPs call for stockpiling of gravel along the road but do not address criteria for locating and managing stockpile sites. Because of the limited nature of the canyon, these stockpiles will most likely be within the 100 year floodplain. Some loss of woody riparian or meadow habitat would occur as the area is cleared and compacted for stockpiling. If insufficient vegetation is left as a buffer between the stockpiles and the river, the stockpiles may act as a point source for sediment input into the river.

Effects to Loach Minnow

Adverse effects to the loach minnow are expected to occur through several direct and indirect mechanisms. The most direct of these is the crushing of loach minnow and their eggs by movement of work equipment and normal-use vehicles on the low-water crossings and by use of machinery within the watered channel during maintenance and repair operations, such as diversion of the river around work sites or repair work on crossing structures. Loach minnows are very susceptible to crushing because of their habit of seeking cover under cobble and boulders and maintaining that position in the presence of disturbance. Loach minnows are also subject to harassment. This may disrupt feeding, resting, and breeding behavior and may expose those individual loach minnows to greater risks of predation, displacement downstream, and other adverse effects.

During road maintenance and repair work and to a lesser extent during normal road use, the potential exists for introduction of toxic substances, such as petroleum products, into the stream. If this occurs, direct mortality of loach minnow may occur. The BMPs address this issue and provide for practices that should minimize the probability of spills and, if they should occur, of any toxic materials reaching the river.

In addition to the direct mortalities, loach minnow would be adversely affected by habitat modification and destruction due to the presence, maintenance, and repair of the road. These modifications are closely tied to the channel and floodplain alterations discussed in the previous section. Some effects are limited to the loach minnow and their habitat within the area of the river paralleled by these roads. Other effects extend downstream and include the entire Blue River population of loach minnows, as well as those in the San Francisco River downstream from the mouth of the Blue River.

Human-caused modifications of the river channel have probably increased the amount of general habitat available to loach minnow in the Blue River. Alteration and simplification of the river channel have resulted in a predominance of wide, shallow, cobble-bottomed habitat which is the preferred habitat type for adult loach minnows. However, although the quantity of adult loach minnows' habitat may have been increased by the channel alteration, there may be microhabitat, habitat quality, and ecosystem instability alterations that may be seriously detrimental to loach

minnow in the long run. Alteration of the Blue River watershed and simplification of the geomorphology of the Blue River affects loach minnow habitat in many ways other than the availability of cobble/gravel riffles. Discharge, velocity, instream water volume, water temperature, nutrient cycling, sedimentation, availability of larval backwater habitats, food availability, and other factors have been altered.

Some riffle habitats in the Blue River that may otherwise be suitable loach minnow habitat may be unsuitable due to sediment deposition or compaction. This is particularly likely as a long-term effect of low-water crossings, which are usually placed on shallow riffles. Vehicular use compacts the substrate, thus eliminating the under-cobble pockets needed by loach minnows. This would also occur, at least temporarily, in areas where machinery is used within the wetted channel, for emergency road material gathering, stream diversion, bridge repairs, or other work. Deposition of fine sediment would adversely affect loach minnow habitat. Adverse effects of stream sedimentation to fish and fish habitat have been extensively documented (Murphy *et al.*, 1981; Wood *et al.*, 1990; Newcombe and MacDonald, 1991; Barrett, 1992; Megahan *et al.*, 1992; Waters, 1995; Newcombe and Jensen, 1996). Because of their benthic habit, loach minnow and their eggs are particularly vulnerable to substrate sedimentation which reduces available habitat and smothers eggs (Propst *et al.*, 1988).

Human-caused alterations of the Blue River, including those caused by the existence, repair, and maintenance of the road, may also have other adverse effects to loach minnows. Although no empirical data exists, it is likely that the base flow of the Blue River has declined substantially since the 1800's. This is supported by anecdotal information that the Blue River formerly had a larger base flow and did not lose surface flow in sections during summer, as it now does (Coor 1992). This water loss is due, in part, to the consumptive use of water by residential, agricultural, and commercial uses. A probable primary cause is the alterations of the watershed and the river channel which have reduced the ability of the river to store water. Rains now run off more rapidly creating the more "flashy" hydrograph that now exists (USGS, 1978, 1991, 1996). The faster movement of water through the system results in less storage and lower base flows. The increased width to depth ratio and the more open channel with less riparian and bank shading also causes greater water loss to evaporation and percolation. Depletion of low flows, including complete loss of surface water during some summers in some areas, adversely affects loach minnows. Loach minnows in the areas which dry are killed. While loach minnows may move into runs and pools when riffles dry, those habitats are rare in the Blue River and loach minnows are unlikely to survive in those habitats for very long due to increased predation and unsuitable conditions. Loach minnows in areas where flow is severely reduced may die or become severely stressed due to overcrowding, disease, high water temperatures, and decreased oxygen levels.

Although loach minnow temperature tolerances are unknown, summer water temperatures in the upper Blue River can be high, reaching at least into the mid 80's (USGS, 1978). The sparseness

of the riparian vegetation and the open shallow character of the channel make the Blue River prone to both high water temperatures and high temperature fluctuations (Tait *et al.*, 1994; Li *et al.*, 1994). While adult loach minnow appear to be rather tolerant of high temperatures, the temperature fluctuations may be adversely affecting larval loach minnow. Larvae have a much more limited thermal range than do adults and exhibit subtle habitat shifts to accomplish thermal regulation. Large temperature fluctuations in shallow edgewater habitats may cause larvae to die from thermal shock or may cause them to move into deeper, faster water where they are more vulnerable to predation or to being swept downstream. Failure to restore a more natural temperature regime through better management of the riparian and aquatic habitats may be preventing loach minnows in the Blue River from establishing a larger population.

The presence, use, maintenance, and repair of the Blue River road have contributed to a reduced habitat complexity in the Blue River. Except in the uppermost sections, the habitat is almost entirely shallow, sand/cobble riffles and runs. Pools, backwaters, shear zones, eddies, silt substrates, woody debris cover, overhanging banks, and other habitat components have been reduced to minor constituents of the aquatic habitat of the Blue River system; a consequence of the alterations of channel geomorphology and riparian vegetation. The Service believes that habitat simplification has been an important contributor to the decline of the loach minnow. Reduction of habitat complexity increases inter-species and inter-lifestage conflicts. It exacerbates the adverse effects of generalistic nonnative species on native species (Bestgen, 1986; Minckley and Rinne, 1991; Baltz and Moyle, 1993; Douglas *et al.*, 1994). Although there are few nonnative species in the Blue River, several of them are predatory and decreased habitat complexity results in decreased hiding cover, thus making native species, that are susceptible to predation, more vulnerable to predation (Minckley, 1983; Fraser *et al.*, 1987). Cover is also an important factor in the ability of fish species to avoid adverse effects from flooding (Bulkley and Pimentel, 1983; Meffe, 1984). The road and other human disturbances have increased the flood volume, velocity, and abrasive power at the same time as they have increased the vulnerability of the loach minnow and other fish in the Blue River to population size reductions from flooding.

The short lifespan of the loach minnow makes its vulnerable to serious adverse effects from short-term events. Regarding the short lifespan, Propst *et al.* (1988) stated:

> *This fact, coupled with the comparatively low fecundity of the species, means that any catastrophe that eliminated or greatly reduced a year-class would severely deplete recruitment to a population. For example, excessive sedimentation during the spawning season might suffocate a large portion of that year's reproductive effort. This year-class would then be largely absent within the population. In the succeeding year, total reproductive effort would be diminished because of decreased abundance of Age I fishes. Although Age I females are less fecund than Age II females, the former outnumber the latter by a considerable margin. The net effect would be a major reduction in*

population size. If this scenario were to occur every three to four years, a loach minnow population could be eliminated in less than a decade. If such a situation occurred two or three years consecutively, a population could be eliminated more rapidly.

Therefore, although many road effects may be short-lived, they may have severe consequences to loach minnow if they affect reproduction or recruitment. This inherent vulnerability to short-term perturbations may combine with another life history characteristic of loach minnow that also may increase vulnerability to adverse effects; the cyclical nature of the populations. As with many short-lived species, populations of loach minnow undergo substantial fluctuations in abundance between years (Propst *et al.*, 1988). When population numbers are at or near the high end of the cycle, the loach minnow may be able to withstand substantial adverse effects. The same effects, if they occur at the low point of the population cycle, may be much more serious and could potentially result in extirpation of the species from the affected area. The combination of a short-lived impact severely reducing reproduction and/or recruitment during a low point in the population cycle could raise effects that are on the average considered to be only moderate to catastrophic levels. For example, since flooding and the need for emergency repair work on the road often coincide with the early part of loach minnow spawning in the spring, substantial road repair-related losses of reproduction and recruitment to road repair work could be expected during those years when spring flooding occurs. Spring is also when the loach minnow population is at its yearly low following winter mortalities; therefore, losses of adults are more significant to the population than at other times. If in some year, this scenario also coincides with the low-point in the population fluctuation cycle, then road repair-related losses of adults, eggs, and larvae could be catastrophic to the population, which might become locally extirpated from the upper Blue River.

The loach minnows is the rarest of the five remaining native fish species in the Blue River. Even where the densities are highest in the Blue River, loach minnow is still relatively scarce, rarely constituting more than 10%, and often less than 5%, of the fish population (AGFD, 1994; Bagley *et al.*, 1995). This is the same pattern of rarity noted for the species in the Gila River in New Mexico, which retains seven native fish species (Propst and Bestgen, 1991). How the present rarity in the Blue and Gila Rivers relates to the historic relative abundance of the loach minnow is unknown; however, in Aravaipa Creek in Arizona, which retains seven native species, loach minnows often make up 10-15% of the fish population and in some portions of the stream can comprise over 30% (Velasco 1994; AGFD 1992-93). The relative abundance of fish species can be highly variable and may be affected by numerous factors.

The Blue River road affects habitat of loach minnow along 30 miles of the river and has downstream effects for many more miles, probably to the mouth of the Blue River and downstream into the San Francisco. Assuming an action area of effects of 60 miles of river, the proposed action adversely affects slightly over 20% of the presently known range of the

loach minnow. The loach minnow in the Blue River are genetically distinct and this population is considered critical to the survival and recovery of the species (Tibbitts 1992).

Effects to Razorback Sucker

Effects to the razorback sucker would be similar to those previously discussed for the loach minnow. However, razorback suckers use pool, rather than riffle, habitat. Therefore, the potential for direct mortality of adult razorback suckers during vehicular operation in the watered channel is extremely low. There is the potential for death of larval and juvenile razorback suckers in shallow edgewaters on low-water crossings and other areas of machinery use. The probability of this is considered low since the likelihood that razorback suckers are reproducing in the Blue River is low.

The alteration and maintenance of the Blue River as a predominantly riffle/run habitat is a major adverse effect to the recovery of razorback suckers in the river. Razorback suckers need pool habitat, which is scarce. The reasons for the lack of pool habitat have been discussed earlier and are related to the overall alteration of the river channel and the deposition of sediment. The existence, maintenance, and repair of the road has, and continues to, contribute to maintenance of the present lack of pool habitat.

Effects to Bald Eagle

Adverse effects to bald eagles from the existence, use, maintenance, and repair of the Blue River road are related primarily to the loss of perching habitat. Wintering bald eagles require perching sites, the most common of which are large riparian trees, either living or dead (Grubb and Kennedy, 1982). The channel instability and erosion, widening of the active channel into a cobble plain, and reduction of the fine-soiled banks and terraces has caused the loss of large portions of the riparian vegetation. As discussed earlier, there have been a number of human activities which have contributed to this alteration, with the road being one of the more important factors. The maintenance and repair activities on the road continue to result in losses of riparian trees. Although the BMPs have provisions to minimize the removal of large trees and riparian vegetation in general, there are still a number of maintenance and repair activities, such as gravel mining, gravel stockpiling, low-water crossing clearing, etc., that would result in losses of seedlings and saplings. Without adequate recruitment of young trees, the large trees will not be replaced as they die.

Some adverse effects to bald eagle may occur as a result of disturbances of roosting or perching bald eagles. Use of heavy machinery near roosting or perching bald eagles may cause

disturbance of the birds, decreasing foraging productivity and increasing energy requirements during winter periods when energy requirements are high and food availability may be low.

Effects to Southwestern Willow Flycatcher

The present degraded state of the riparian habitat in the upper Blue River is not suitable for breeding by southwestern willow flycatcher. This condition is, as we have described earlier, due in part to the historic presence and use of the Blue River road. In addition, the continuing existence, repair and maintenance of the roads suppress recovery of the riparian habitat by removing or damaging riparian vegetation, causing erosion, precluding conditions suitable for recruitment of woody riparian, preventing rebuilding of fine-soiled banks, and promoting instability in the river channel. The Service expects that implementation of the BMPs is likely to remove some of these adverse effects and may allow riparian recovery to the point at which southwestern willow flycatchers may reoccupy the area. However, even with the BMPs, the use, maintenance, and repair of the road will have sufficient disruptive influence that in combination with the other factors, may inhibit full riparian recovery. Continued disruption and loss of riparian vegetation will occur during gravel mining, gravel stockpiling, work on low-water crossings, filled terraces, and other riverbank sites.

The presence of southwestern willow flycatchers in proximity to the project area indicates that the potential for reoccupation is high if the riparian habitat on the Blue River can be restored to sufficient health. The use, maintenance, and repair of the road is a significant factor in inhibiting that restoration. Because the development and extent of the riparian habitat will probably remain limited in comparison to historical conditions, continuing use and maintenance of the road may preclude recovery of the southwestern willow flycatcher in the Blue River drainage.

Precluding development and maintenance of significant riparian habitats along the Blue River is likely to affect flycatchers migrating through the drainage. Given the Blue River's proximity and orientation relative to nearby breeding sites on the San Francisco and Little Colorado rivers, flycatchers probably migrate through the Blue River drainage. Migratory, or possibly resident flycatchers were detected on the Blue River in 1989. Stopover sites for feeding and resting are critical for migratory birds and it is likely that flycatchers nesting nearby rely on riparian resources within the action area. Precluding recruitment of riparian habitat on the Blue River could affect migrating flycatchers.

Effects to Peregrine Falcon

Effects to peregrine falcon from the proposed project are related to disturbance of breeding falcons. If peregrine falcon nests are present in the cliffs within one-half mile of the road, the

noise and activity associated with nearby heavy machinery use during the species breeding season may result in falcons not attempting nesting, abandoning the nest, or neglecting their young. Maintenance and repair of FR 281 may occur at any time of the year. Flooding is likely to occur in March and April, thus requiring maintenance and repair activities during breeding season of peregrine falcons.

The degree of disturbance that peregrine falcons can tolerate is generally believed to be a function of the magnitude of the disturbance, the distance from the breeding site, and the falcon's habituation to human activities. Raptors in frequent contact with human activities tend to be less sensitive to additional disturbances than raptors nesting in remote areas. However, exposure to direct human harassment may make raptors more sensitive to disturbances (Newton, 1979). Where prey is abundant, raptors may even occupy areas of high human activity, such as cities and airports (Newton, 1979; Ratcliffe, 1980; White *et al.*, 1988). The timing, frequency, and predictability of the disturbance may also be factors. Raptors become less sensitive to human disturbance as their nesting cycle progresses (Newton, 1979). Generally, peregrine falcons are least tolerant of disturbance during the prelaying through incubation periods. After young are hatched, peregrines exhibit considerably higher levels of tolerance and are unlikely to abandon the nesting attempt (Cade, 1960; Cade and White, 1976; Fyfe and Olendorff, 1976; Eberhardt and Skaggs, 1977; Olsen and Olsen, 1978; Monk, 1980; Roseneau *et al.*, 1981).

Studies have suggested that human activities within breeding and nesting territories could affect raptors by changing home range movements (Anderson *et al.*, 1990) and causing nest abandonment (Porter *et al.*, 1973; Postovit and Postovit, 1987). In areas of steep topographic "screening," Johnson (1988) suggests that human activity within a core area of about 1,300 feet of the nest might impact peregrine breeding efforts. His recommended core area increased to 2,950 feet in areas with no topographic screening. He based these distances on a model using thresholds for flight responses, not on verified impacts on productivity.

Exposure to direct human harassment may make raptors more sensitive to disturbances (Newton, 1979). Construction activities, operation of heavy machinery, and aircraft activity, all with the notable absence of direct human harassment, were generally tolerated by nesting peregrine falcons and gyrfalcons (Platt, 1977; Ellis, 1981; Haugh, 1982; White and Thurow, 1985; Ritchie, 1987; White *et al.*, 1988). Peregrines have nested in situations where there is a high level of disturbance, such as on buildings in urban settings (Cade and Bird, 1990). They have also nested near potential disturbance from low level military jets and sonic booms (Ellis, 1981). Peregrine falcons and golden eagles have been known to nest successfully within a few hundred meters of areas such as airports, blasting, construction, quarrying, and mining sites (Pruett-Jones *et al.*, 1980; Haugh, 1982; White and Thurow, 1985; White *et al.*, 1988). Cade and Bird (1990) discussed the possible effects on peregrines of high levels of human activity, including noise and machinery such as compressors, blowing fans, and bright night lighting. They

concluded that the effects were unknown. Apparently, responses vary considerably within and among species.

In the proposed project area, nesting peregrine falcons may be somewhat habituated to the occasional vehicular noise associated with normal road use. However, operation of heavy machinery does not occur frequently enough in any given site along the road to lead to habituation to that level of noise. Depending upon the specific cliff area, there may be very little or a lot of "screening" of the cliffs from noise and movement associated with road maintenance and repair. Johnson (1994) found that nesting areas in New Mexico with frequent human activity are generally occupied irregularly, and peregrines in areas with occasional disturbance suffer reproductive failure more often than those in undisturbed areas. The cumulative effects of disturbance are difficult to ascertain. While peregrines may learn to ignore certain regular and repeated stimuli, cumulative effects of minor disturbances may accumulate above tolerance levels. Given the large amount of potential nesting habitat in the project area and the likelihood of maintenance and repair activities occurring during the breeding season, the proposed action has the potential to adversely affect the peregrine falcon.

CUMULATIVE EFFECTS

Cumulative effects are those effects of future non-Federal (State, local government, or private) activities on endangered or threatened species or critical habitat that are reasonably certain to occur during the course of the Federal activity subject to consultation. Future Federal actions are subject to the consultation requirements established in section 7 and, therefore, are not considered cumulative in the proposed action.

Most of the land within the Blue River watershed is under the jurisdiction of the U.S. Forest Service and activities affecting the loach minnow, razorback sucker, bald eagle, southwestern willow flycatcher, and peregrine falcon, such as grazing and timber harvest, would be Federal actions which are subject to section 7 consultation. Recreation in the area is light to moderate and in general has localized impacts on the river in the project area. The primary cumulative effects come from private land needs in the valley bottom on the upper Blue River. Livestock grazing, cropping and residential development on the floodplain terraces remove water from the river and add to the instability of the river system. An aquaculture operation feeds predatory nonnative fish species into the Blue River, diverts water from the river, and adds to the nutrient load of the river. The role of these private activities has been discussed in more detail in the environmental baseline section of this opinion.

In 1991, the American Fisheries Society adopted a position statement regarding cumulative effects of small modifications to fish habitat (Burns, 1991). That statement concludes that accumulation of localized or small impacts, often from unrelated human actions, pose a serious

threat to fisheries. It also points out that some improvement efforts to fish habitat may not result in cumulative increases in the status of the species, but instead may simply mitigate cumulative habitat alterations from other activities. Amelioration of existing adverse effects from the existence and use of the roads in the upper Blue River drainage, through application of BMPs to its maintenance and repair, appears to meet this description. The values of BMPs may only partially mitigate for past and future accumulating habitat alterations in the upper Blue River watershed, leaving substantial cumulative and accumulative impacts that need to be ameliorated to provide for recovery of the listed species in the Blue River ecosystem.

SUMMARY OF EFFECTS

The Blue River aquatic and riparian communities are degraded. Nine fish species, 65% of the native fish fauna, have been extirpated from the river system, although one is being reintroduced with limited success. Floodplain soils have been lost and riparian vegetation has been reduced throughout much of the river to sparse stands with little reproduction and little understory or herbaceous cover. Various uses in the watershed and valley bottom are major factors in this degradation. The existence, use, repair and maintenance of roads, particularly within the floodplain, are a substantial part of these impacts.

Loach minnows are the rarest of the five remaining native fish species of the Blue River. It is distributed throughout the system, but it consistently makes up less than 10% of the fish in any given area. Loach minnows may be impacted during maintenance and repair work in the river channel and during use of low-water crossings. The degraded nature of the Blue River channel and the aquatic habitat have removed much of the resilience needed to support the ecosystem over the long-term. Base flows in the river become critically low during dry periods and in some areas all surface flow may be lost. The existence, use, maintenance, and repair of the road are significant contributing factors to the past and ongoing degradation of the aquatic and riparian habitats and may preclude their recovery. Threats to the loach minnow are increasing rangewide and the Service believes the species may warrant uplisting to endangered. The loach minnows in the Blue River are genetically distinct from other populations and are one of only six populations. The Blue River road directly affects about 20% of the known range of loach minnows. The Blue River loach minnow population is considered critical to the survival and recovery of the species.

Razorback suckers were extirpated and the pool habitat needed by this species has been reduced to a minor component of the aquatic habitat in the Blue River. It is unknown whether the reintroduction of this species into the Blue River is successful.

Bald eagles commonly use the Blue River for wintering habitat. The snags and large riparian trees they need for roosting and perching have a low replacement rate due to human degradation

of the riparian area, including road repair and maintenance. Disturbance of bald eagles may occur during road maintenance and repair operations with adverse effects.

Southwestern willow flycatchers may have occupied the Blue River, as they are present in several nearby areas. The dense riparian habitat needed by this species has been lost due to various activities, including the use, repair and maintenance of roads.

Peregrine falcons are found in the area, although they are not known from the immediate vicinity of the road. Potentially suitable habitat exists and road maintenance and repair activities may result in disturbance that harasses falcons using those cliffs or precludes them from making use of those habitats.

The environmental baseline of the Blue River and its listed species is seriously degraded. The system is threatened by the accumulation of many Federal and private actions within the watershed. For razorback sucker, bald eagle, southwestern willow flycatcher, and peregrine falcon, the Blue River habitats are not sufficiently crucial to the survival and recovery of the species for the degraded environmental baseline to have reached to point of jeopardy. For loach minnow, the Blue River is a crucial habitat and the Service believes the degraded condition of the environmental baseline of the species and Blue River aquatic and riparian ecosystem constitutes a jeopardy situation from which the additional proposed actions must be analyzed -- does the proposed action improve or further degrade the baseline? The interim increment of 12 months of existence, use, repair and maintenance of the roads is expected to contribute adversely to the baseline condition, although the overall contribution is small in relation to the whole, due to the short time period, and therefore limited work, involved. Limitations on work within the wetted channel during the loach minnow spawning season, as agreed to by the Forest Service and COE, and as incorporated into Incidental Take Statement of this opinion, will also help limit adverse impacts. The proposed actions for initiating a process to develop and implement a long-term solution to road impacts improves the baseline condition, although only providing it is part of a larger planning process, the solution from which would not be implemented until a later time. Consideration of the improvements to the baseline condition based on the long-term solution efforts is predicated on the commitment of the Forest Service and COE to engage in additional planning and implementation efforts and section 7 consultation beyond the 12-month interim period.

CONCLUSION

After reviewing the current status of the loach minnow, razorback sucker, bald eagle, southwestern willow flycatcher, and peregrine falcon, the environmental baseline for the action area, the direct and indirect effects, and cumulative effects of the emergency and proposed actions, it is the Service's biological opinion that implementation of repair and maintenance (both

emergency and under the BMPs) on County-maintained roads within the upper Blue River drainage for an interim 12-month period is not likely to jeopardize the continued existence of the loach minnow, razorback sucker, bald eagle, southwestern willow flycatcher, or peregrine falcon.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act, as amended, prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish and wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered a prohibited taking provided that such taking is in compliance with the incidental take statement. The measures described below are nondiscretionary, and must be undertaken by the agency or made a binding condition of any grant or permit issued to the applicant, as appropriate.

ANTICIPATED LEVEL OF INCIDENTAL TAKE

If, during the course of the action, the amount or extent of the incidental take anticipated is exceeded, the Forest Service and COE must reinitiate consultation with the Service immediately to avoid violation of section 9. Operations must be stopped in the interim period between the initiation and completion of the new consultation, if it is determined that the impact of the additional taking will cause an irreversible and adverse impact on the species. The Forest Service and COE should provide an explanation of the causes of the taking.

Loach Minnow and Razorback Sucker Anticipated Incidental Take

The Service anticipates that the emergency repair work and the proposed normal maintenance and repair using the BMPs on the County-maintained roads in the Blue River drainage, during the interim 12-month period, may result in incidental take of loach minnow and razorback sucker through direct mortality and through indirect mortality resulting from habitat loss or alteration. Adult or larval loach minnow or loach minnow eggs and larval or juvenile razorback sucker present in work areas may be crushed by machinery, poisoned by accidental introduction of toxic substances, or smothered by sediment input. Indirect take may also potentially occur through destruction or alteration of habitat resulting from bank and riparian modification and channel destabilization.

The anticipated level of incidental take of loach minnow cannot be directly quantified due to the low level of data on the loach minnow population in the area and the inability to predict long-term project effects. Because of their small size and benthic habitat and due to the velocity of the river, it is unlikely that loach minnow or eggs killed as a result of the proposed project would be observed. The anticipated level of incidental take of razorback sucker cannot be directly quantified due to lack of information on the razorback sucker population in the area. Therefore, anticipated levels of take for both species are indexed to the total fish community and habitat. Anticipated take for loach minnow and razorback sucker for the proposed action will be considered to have been exceeded if at any time during project activities:

1. more than 20 dead fish of any species are found in the area of any road repair or maintenance activity or within 500 yards downstream,

2. maintenance or repair work occurs outside the road easement (33 feet on each side of the centerline of the road),

3. any spill of toxic materials occurs in the Blue River or its floodplain during road repair or maintenance activities.

Bald Eagle Anticipated Incidental Take

The Service anticipates that the emergency repair work and the proposed normal maintenance and repair using the BMPs on the County-maintained roads in the Blue River drainage, during the interim 12-month period, would not result in incidental take of bald eagle.

Although adverse effects were noted in the section entitled "Effects to the Bald Eagle," the Service feels that, because this area is used by fluctuating numbers of wintering bald eagles, and wintering bald eagles are more opportunistic with respect to habitat requirements than breeding bald eagles, the proposed project is not likely to result in take. Additionally, the reasonable and prudent measures provided for the loach minnow address many of the concerns the Service has with respect to the bald eagle and protection and regeneration of existing riparian habitat.

Southwestern Willow Flycatcher Anticipated Incidental Take

The Service anticipates that the emergency repair work and the proposed normal maintenance and repair using the BMPs on the County-maintained roads in the Blue River drainage, during the interim 12-month period, would result in take in the form of harm to migratory southwestern willow flycatchers. Precluding development of significant riparian habitats in the action area would limit opportunities for feeding and sheltering. Thus, southwestern willow flycatchers

migrating through the Blue River are likely to experience higher rates of mortality due to starvation and increased exposure to predators.

The anticipated level of incidental take of the southwestern willow flycatcher cannot be quantified due to the lack of data on the numbers of flycatchers occurring in the action area. No surrogate measures for take have been identified.

Peregrine Falcon Anticipated Incidental Take

The Service anticipates that the emergency repair work and the proposed normal maintenance and repair using the BMPs on the County-maintained roads in the Blue River drainage, during the interim 12-month period, may result in incidental take peregrine falcons in the form of harassment due to disruption of normal reproductive behavior. This harassment is in the form of disturbance during maintenance and repair activities.

Brown *et. al.* (1992) reported a mean density of one occupied peregrine breeding area every 5.6 kilometers (3.4 miles) of linear rim habitat for peregrine falcons on the south rim of Grand Canyon National Park in 1989. Similar work in Zion National Park and Glen Canyon Recreational Area indicated that the minimum distance between occupied breeding areas was 4.8 kilometers (3.0 miles) (Brown *et al.*, 1992). Using these figures, one can conservatively assume that peregrine falcons may be spaced at a minimal distance of 3 miles apart given continuous linear habitat. Therefore, the 16 linear miles of potential nest habitat in the project area could be occupied by up to 5 breeding pairs. The Service recognizes that the habitat along the Blue River within the project area may not be of the same high quality as that located in the Grand Canyon and the other cited areas, and that the 16 linear miles of habitat reported in the project area are not evenly distributed. We use the data from these areas to predict the maximum number of eyries that may be present in the project area for the purposes of determining incidental take.

The Service anticipates that the proposed action could result in the harassment of up to 5 potential nesting sites, resulting in the incidental take of up to 10 adult and 20 young peregrine falcons for 12 months due to:

1. temporary reduction or elimination of successful fledging of young in habitat located within one-half mile of maintenance and repair activities actions, for the 1997-98 breeding seasons, and

2. vacancy of existing breeding sites located within one half mile of maintenance and repair activities, for the 1997-98 breeding seasons.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the incidental taking authorized by this biological opinion. Some of the reasonable and prudent measures and their implementing terms and conditions are already an implicit or explicit part of the proposed project and their inclusion in this incidental take statement is only an affirmation of their importance in minimizing take. Where the proposed project already adequately fulfills the following reasonable and prudent measures and terms and conditions, this incidental take statement does not imply any requirement for additional measures. No reasonable and prudent measures have been identified for the bald eagle or southwestern willow flycatcher.

1. Conduct all proposed actions in a manner which will minimize direct mortality of loach minnow and razorback sucker.

2. Conduct all proposed actions in a manner which will minimize loss and alteration of loach minnow and razorback sucker habitat.

3. Monitor the fish community and habitat to document levels of incidental take.

4. Conduct all proposed actions in a manner which will minimize harassment of peregrine falcon.

5. Conduct annual surveys for peregrine falcon, using the Arizona Game and Fish Department protocol, within the project area.

6. Maintain complete and accurate records of actions which may result in take of peregrine falcon, loach minnow, razorback sucker and their habitat.

TERMS AND CONDITIONS FOR IMPLEMENTATION

In order to be exempt from the prohibitions of section 9 of the Act, the Forest Service and COE are responsible for compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions should be incorporated into the BMPs, when not already included.

1. The following terms and conditions will implement reasonable and prudent measure 1.

1.1 In addition to the provisions of the BMPs, all reasonable efforts shall be made to minimize activities within the wetted channel of the Blue River.

1.2 Except during emergency situations, all work requiring entry of vehicles or equipment into surface water will not be conducted during loach minnow spawning season (March 1 to June 1 and September 1 to October 31).

1.3 All reasonable efforts shall be made to minimize removal of large woody debris from the river channel. Only that debris which poses a specific significant threat to protection of the road shall be removed.

1.4 In addition to the provisions of the BMPs, all reasonable efforts shall be made to minimize rerouting or diversion of the river channel.

2. The following terms and conditions will implement reasonable and prudent measure 2.

2.1 In addition to the provisions of the BMPs, all reasonable efforts shall be made to minimize damage to or loss of riparian vegetation.

2.2 A provision shall be added to the BMPs Action 1, section R-5 2-18, item 3, subitem 7), that although a maximum of six sites may be disturbed in any given year, all reasonable efforts shall be made to minimize the number of sites disturbed while still complying with the other parameters described in item 3.

2.3 All reasonable efforts shall be made to minimize the use or construction of bypass roads.

2.4 A provision shall be added to item 41.15 of Action 3 of the BMPs that projects anticipated to take longer than a season to complete will require additional consultation with the Service.

3. The following terms and conditions will implement reasonable and prudent measure 3.

3.1 At all times when project activities are ongoing in or within 100 yards of the river, all reasonable efforts shall be maintained to monitor for the presence of dead or dying fish in or within 500 yards downstream of the project area. The Service shall be notified immediately by telephone upon detection of more than 20 dead or dying fish of any species. Operations must be stopped in the interim period between the notification and completion of a new consultation if it is determined that the impact

of the additional taking will cause a irreversible and adverse impact on loach minnow or razorback sucker.

3.2 A biologist shall be present during river diversion, rerouting, or returning to earlier channels to monitor for take and advise and assist crews in application of these terms and conditions.

4. The following term and condition will implement reasonable and prudent measure 4.

4.1 Except during emergency situations, all work along portions of the roads where peregrine falcons are known to be present with one-half mile, based on monitoring (see term and condition 5.1), shall occur outside the peregrine falcon breeding season (March 1 to July 15).

5. The following terms and conditions will implement reasonable and prudent measure 5.

5.1 The monitoring shall determine, to the maximum extent possible, occupancy and reproductive status of peregrine falcon in the project area using the Arizona Game and Fish Department Peregrine Falcon Survey Methodology (Ward, 1994).

5.2 Survey/monitoring shall be conducted at primary disturbance sites (approximately 1 mile radius from operations such as gravel extraction, stockpile sites, and road repair areas) and other high potential sites in the project area, during 1998. Survey of the entire project area should be initiated to facilitate future consultation on the Blue River roads.

6. The following term and condition will implement reasonable and prudent measure 6.

6.1 The annual report to the Forest Service and Service required by the BMPs shall also be submitted to COE. In addition to the information required in the BMPs, the report shall include a discussion of the compliance with the above terms and conditions. Results of all monitoring, including complete and accurate records of all incidental take observed during monitoring, shall be included.

Note: While the incidental take statement provided in this consultation satisfies the requirements of the Endangered Species Act, as amended, it does not constitute an exemption from the prohibitions of take of listed migratory birds under the more restrictive provisions of the Migratory Bird Treaty Act.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. The term conservation recommendations has been defined as Service suggestions regarding discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's 7(a)(1) responsibility for these species.

1. The Service recommends that except during emergency situations, all work along portions of the road where potential peregrine falcon nesting habitat is present should not take place during the peregrine falcon breeding season (March 1 to July 15).

2. The Service recommends that the Forest Service and COE monitor for occupancy of peregrine falcon within the entire project area in 1998. Funding/assistance from the Arizona Game and Fish Department and other sources should be pursued.

3. The Service recommends that the Forest Service and COE terminate gravel mining in the Blue River and its tributaries, both on private and Federal property. Although the RPA will provide for long-term solutions to gravel supply for the road, a moratorium on gravel mining while those solutions are being formulated would be of benefit the ecosystem and the listed species.

4. The Service recommends that the Forest Service and COE conduct annual surveys within the action area for southwestern willow flycatchers. Surveys should be conducted by trained personnel using the current protocol (Sogge *et al.*, 1997) and should, at a minimum, focus on determining the number and locations of migratory flycatchers.

5. The Service recommends that the Forest Service and COE complete a standardized riparian mapping project for the upper Blue River to serve as a baseline for monitoring improvements in riparian habitats that may result from implementing BMPs or other changes in watershed management.

6. The Service recommends that the Forest Service and COE continue to conduct or assist AGFD in conducting wintering bald eagle surveys with the intent of determining the specific habitat components used by the bald eagle along the Blue River. Of particular interest is whether or not bald eagles consistently return to the same topographic or vegetation features during the winter.

7. The Service recommends that the Forest Service and COE determine the prey base supporting bald eagles along the Blue River during the winter.

8. The Service recommends that the Forest Service and COE determine the prey source for bald eagles breeding at Luna Lake. It has been observed through the Bald Eagle Nestwatch Program in 1977 that the adults at Luna Lake are not foraging at the Lake. The Blue River is one of the few remaining areas where foraging is potentially occurring. Additionally, determine whether or not breeding birds from Luna Lake may winter at the Blue River.

In order for the Service to be kept informed of actions that either minimize or avoid adverse effects or that benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendation.

REINITIATION NOTICE

This concludes formal consultation on implementation of repair and maintenance (both emergency and under the BMPs) of County-maintained roads within the upper Blue River drainage in Greenlee County, Arizona during an interim 12-month period, beginning with the date of this biological opinion. As required by 50 CFR 402.16, reinitiation of formal consultation is required if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may impact listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

We appreciate the ongoing efforts of the Forest Service and COE in conserving the native ecosystem of the Blue River. If we can be of further assistance, please contact myself or Bruce Palmer.

Sincerely,

Sam F. Spiller
Field Supervisor

7. The Service recommends that the Forest Service and COE determine the prey base supporting bald eagles along the Blue River during the winter.

8. The Service recommends that the Forest Service and COE determine the prey source for bald eagles breeding at Luna Lake. It has been observed through the Bald Eagle Nestwatch Program in 1977 that the adults at Luna Lake are not foraging at the Lake. The Blue River is one of the few remaining areas where foraging is potentially occurring. Additionally, determine whether or not breeding birds from Luna Lake may winter at the Blue River.

In order for the Service to be kept informed of actions that either minimize or avoid adverse effects or that benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendation.

REINITIATION NOTICE

This concludes formal consultation on implementation of repair and maintenance (both emergency and under the BMPs) of County-maintained roads within the upper Blue River drainage in Greenlee County, Arizona during an interim 12-month period, beginning with the date of this biological opinion. As required by 50 CFR 402.16, reinitiation of formal consultation is required if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may impact listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

We appreciate the ongoing efforts of the Forest Service and COE in conserving the native ecosystem of the Blue River. If we can be of further assistance, please contact myself or Bruce Palmer.

Sincerely,

Sam F. Spiller
Field Supervisor

cc: Director, Fish and Wildlife Service, Washington, D.C. (DES)
Field Supervisor, Fish and Wildlife Service, Phoenix, AZ
Project Leader, U.S Fish and Wildlife Service, Pinetop, AZ
Field Supervisor, U.S. Fish and Wildlife Service, Albuquerque, NM
Regional Solicitor, Dept. of the Interior, Albuquerque, NM (Attn: Beverly Ohline)
District Ranger, Alpine Ranger District, Apache-Sitgreaves National Forest, Alpine, AZ
Chief, Regulatory Branch, U.S. Army Corps of Engineers, Phoenix, AZ

Director, New Mexico Department of Game and Fish, Santa Fe, NM
Director, Arizona Game and Fish Department, Phoenix, AZ
Director, Arizona Division of Emergency Management, Phoenix, AZ
County Engineer, Greenlee County, Clifton, AZ
Chairman, Greenlee County Board of Supervisors, Clifton, AZ
Bill Marks, Blue, AZ

LITERATURE CITED

Abarca, F.J. 1987. Seasonal and diel patterns of feeding in loach minnow (Tiaroga cobitis) Girard). Proceedings of the Desert Fishes Council 20:20.

Anderson, D.E., O.J. Rongstad, and W.R. Mytton. 1990. Home range changes in post-breeding raptors exposed to increased human activity levels in southeastern Colorado. Wildlife Society Bulletin 18:134-142.

Anderson, R. and P.R. Turner. 1977. Stream survey of the San Francisco River. New Mexico Department of Game and Fish, Santa Fe, NM. 13 pp + figs.

Arizona Game and Fish Department. 1992-93. Memoranda of Aravaipa Creek monitoring data. July 11-12, August, November 10-12, and December 8-10, 1992, and February 16-17, March 9-11, May 19-21, June 15-16, and October 23-24, 1993. Arizona Game and Fish Department, Phoenix, AZ.

Arizona Game and Fish Department. 1994. Distribution, abundance and habitat survey for loach minnow (Tiaroga cobitis) in the Blue River, Arizona. August, 1994. Arizona Game and Fish Department, Phoenix, AZ. 19 pp.

Arizona Game and Fish Department. 1996. Wildlife of special concern in Arizona (Draft). Nongame and Endangered Wildlife Program. Arizona Game and Fish Department, Phoenix, Arizona. 23 pp.

Bagley, B., G.W. Knowles, and T.C. Inman. 1995. Fisheries survey of the Apache-Sitgreaves National Forests, trip reports 1-9. May 1994 to September 1995. Arizona State University, Tempe, AZ. 50 pp.

Bahre, C.J. 1991. A legacy of change. Historic human impact on vegetation in the Arizona borderlands. University of Arizona Press, Tucson, AZ.

Baltz, D.M. and P.B. Moyle. 1993. Invasion resistance to introduced species by a native assemblage of California stream fishes. Ecological Applications 246-255.

Barber, W.E. and W.L. Minckley. 1966. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. The Southwestern Naturalist 11(3):313-324.

Barrett, J.C. 1992. Turbidity-induced changes in reactive distance of rainbow trout. Transactions of the American Fisheries Society 121:437-443.

Beatty, G.L. and J.T. Driscoll. 1996. Arizona bald eagle winter count: 1996. Nongame and Endangered Wildlife Program. Arizona Game and Fish Department, Phoenix, AZ. 16 pp.

Beatty, G.L., J.T. Driscoll, and J.G. Koloszar. 1995. Arizona bald eagle nestwatch program: 1995 summary report. Nongame and Endangered Wildlife Program Technical Report Number 85. Arizona Game and Fish Department, Phoenix, AZ.

Belsky, A.J. and D.M. Blumenthal. 1997. Effects of livestock grazing on stand dynamics and soils in upland forests of the interior west. Conservation Biology 11(2):315-327.

Benke, A.C., R.L. Henry,III, D.M. Gillespie, and R.J. Hunter. 1985. Importance of snag habitat for animal production in southeastern streams. Fisheries 10(5):8-13.

Benson, N.G. and A.S. Weithman. 1980. A summary of seven U.S. Fish and Wildlife stream channelization studies. U.S. Fish and Wildlife Service, Kearneysville, WV. 54 pp.

Bent, A.C. 1960. Bent's life histories of North American birds. Vol. II, Land birds. Harper & Brothers, New York. 555 pp.

Berner, L.R. and R.W. Mannan. 1992. Survey for sensitive raptors in the Rincon Mountains of Saguaro National Monument, Arizona. Report to the National Park Service. Cooperative Agreement Number 8000-2-9001. School of Renewable Natural Resources, University of Arizona, Tucson. 18 pp.

Bestgen, K.R. 1986. Red shiner vs. native fishes: replacement or displacement? Proceedings of the Desert Fishes Council 18:209.

Bestgen, K.R. 1990. Status review of the razorback sucker, Xyrauchen texanus. Colorado State Univ. Larval Fish Laboratory, Contribution 44, Ft. Collins, CO. 92 pp.

Bisson, P.A., T.P. Quinn, G.H. Reeves, and S.V. Gregory. 1992. Best management practices, cumulative effects, and long-term trends in fish abundance in Pacific Northwest river systems. Pp. 1-542 In: Watershed management; balancing sustainability and environmental change. Naiman, R.J., Ed. Springer-Verlag, New York, NY.

Blake, E.R. 1953. Birds of Mexico. University of Chicago Press, Chicago, IL. 644 pp.

Blinn, D.W., C. Runck, D.A. Clark, and J.N. Rinne. 1993. Effects of rainbow trout predation on Little Colorado spinedace. Transactions of the American Fisheries Society 122:139-143.

Britt, K.D. 1982. The reproductive biology and aspects of the life history of Tiaroga cobitis in southwestern New Mexico. New Mexico State University, Las Cruces. 56 pp.

Brittingham, M.C. and S.A. Temple. 1983. Have cowbirds caused forest songbirds to decline? BioScience 33:31-35.

Brown, B.T. 1988. Breeding ecology of a willow flycatcher population in Grand Canyon, AZ. Western Birds 19:25-33.

Brown, B.T. 1991. Abundance, distribution, and ecology of nesting peregrine falcons in Grand Canyon National Park, Arizona. SWCA Consultants. Grand Canyon Nation Park, Arizona. 45 pp.

Brown, B.T. 1994. Rates of brood parasitism by brown-headed cowbirds on riparian passerines in Arizona. Journal of Field Ornithology 65:160-168.

Brown, B.T., G.S. Miles, R.L. Glinski, and S.W. Hoffman. 1992. Density of nesting peregrine falcons in Grand Canyon National Park, Arizona. The Southwestern Naturalist 37(2):188-193.

Browning, M.R. 1993. Comments on the taxonomy of Empidonax traillii (willow flycatcher). Western Birds 24:241-257.

Brozka, R.J. 1982. Effects of timber harvesting and associated roads on water quality, and management practices to mitigate these effects: a literature review. New Mexico Natural Resources Department, Santa Fe, NM. 70 pp.

Bryan, K. 1925. Date of channel trenching (arroyo cutting) in the arid southwest. Science 62(1607):338-344.

Bulkley, R.V. and R. Pimentel. 1983. Temperature preference and avoidance by adult razorback sucker. Transactions of the American Fisheries Society 112:601-607.

Burnham, W.T. and J. Enderson. 1987. Three-year report on peregrine falcon surveys in southern Utah National Parks (1985-1987). National Park Service Report CX-1200-5-AO34. The Peregrine Fund, Inc. Boise, Idaho.

Burns, D.C. 1991. Cumulative effects of small modifications to habitat. Fisheries 16(1):12-17.

Cade, T.J. 1960. Ecology of the peregrine and gyrfalcon populations in Alaska. University of California Publications in Zoology 63:151-290.

Cade, T.J. 1982. The Falcons of the World. Cornell University Press. Ithica, New York. 192 pp.

Cade, T.J., and D.M. Bird. 1990. Peregrine falcons, Falco peregrinus, nesting in an urban environment: a review. The Canadian Field Naturalist. Vol. 104, pages 209-218.

Cade, T.J. and C.M. White. 1976. Alaska's falcons: the issue of survival. Living Wilderness 39:35-47.

California Department of Fish and Game. 1992. State and Federal endangered and threatened animals of California (Revised July 1992). California Department of Fish and Game, Natural Heritage Division, Sacramento, California. 13 pp.

Camp Pendleton. 1994. Biological Assessment, riparian and estuarine habitat on Marine Corps Base Camp Pendleton.

Carmichael, G.J., J.N. Hanson, M.E. Schmidt, and D.C. Morizot. 1993. Introgression among Apache, cutthroat, and rainbow trout in Arizona. Transactions of the American Fisheries Society 122:121-130.

Chamberlain, F.M. 1904. "Notes on work in Arizona" Unpublished manuscript in the files of the U.S. Bureau of Fisheries, Dept. of Commerce and Labor, National Archives. U.S. National Museum, Washington, D.C.. 19 pp.

Clifton, C. 1989. Effects of vegetation and land use on channel morphology. Pp. 121-130 In: Practical approaches to riparian resource management. An educational workshop. May 8-11, 1989. Billings, Mont. Gresswell, R.E., B.A. Barton, and J.L. Kershner, Eds. U.S. Bureau of Land Management, Billings, Mont.

Collins, B. and T. Dunne. 1990. Fluvial geomorphology and river-gravel mining: a guide for planners, case studies included. California Dept. of Conservation, Sacramento, CA. 29 pp.

Colmer, G.K. 1992. Watershed cumulative effects analysis for Campbell timber sale area/Campbell Blue watershed. U.S. Forest Service, Springerville, AZ. 19 pp + app.

Cooper, C.A. 1996. Summary of 1995 surveys for willow flycatchers in New Mexico. New Mexico Department of Game and Fish, Sante Fe, NM. 27 pp.

Coor, C.C. 1992. Down on the Blue. Blue River, Arizona, 1878-1986. Blue River Cowbelles. Art Printing West, Goodyear, AZ.

Courtenay, W.R. and J.R. Stauffer,Jr.. 1984. Distribution, biology, and management of exotic fishes. Johns Hopkins University Press, Baltimore, Maryland. 430 pp.

Craig, G. 1986. Peregrine Falcon. Audubon Wildlife Report 1986.

Creef, E.D., R.W. Clarkson, and D.K. McGuinn-Robbins. 1992. Razorback sucker (Xyrauchen texanus) and Colorado squawfish (Ptychocheilus lucius) reintroduction and monitoring, Salt and Verde Rivers, Arizona, 1991-1992. Arizona Game and Fish Department, Special Report on Project E5-3, Job 7, Phoenix, AZ. 22 pp.

DeBano, L.F. and L.J. Schmidt. 1989. Interrelationships between watershed condition and health of riparian areas in southwestern United States. Pp. 45-52 In: Practical approaches to riparian resource management. An educational workshop. May 8-11, 1989. Billings, Mont. Gresswell, R.E., B.A. Barton, and J.L. Kershner, Eds. U.S. Bureau of Land Management, Bilings, Mont.

Dobyns, H.F. 1981. From fire to flood: historic human destruction of Sonoran Desert riverine oasis. Ballena Press Anthropological Papers No. 20, 222 pp.

Douglas, M.E., P.C. Marsh, and W.L. Minckley. 1994. Indigenous fishes of western North America and the hypothesis of competitive displacement: Meda fulgida (Cyprinidae) as a case study. Copeia 1994(1):9-19.

Duce, J.T. 1918. The effect of cattle on the erosion of canon bottoms. Science 47:450-452.

Dunne, T. and L.B. Leopold. 1978. Water in environmental planning. Freeman Press, San Francisco, CA.

Eberhardt, K.C. and R.W. Skaggs. 1977. Nesting peregrine falcons in the Gila National Forest, New Mexico: behavior and ecology. Chihuahua Desert Research Institute, Alpine, Texas. 43 pp.

Ellis, D.H. 1981. Responses of raptorial birds to low level military jets and sonic booms. Inst. Raptor Studies, Oracle AZ. 59 pp.

Ellis, D.H. 1982. The peregrine falcon in Arizona: habitat utilization and management recommendations. Inst. Raptor. Studies, Oracle, AZ. 23 pp.

Enderson, J.H., A. Harmata, W.G. Hunt, L. Kiff, C. White. 1991. Draft addendum to Pacific and Rocky Mountain/Southwest Peregrine Falcon Recovery Plans. Submitted to U.S. Fish and Wildlife Service, January 1991. 24 pp.

Erman, D.C., J.D. Newbold, and K.B. Roby. 1977. Evaluation of streamside bufferstrips for protecting aquatic organisms. California Water Resources Center, Univ. of California, Davis, CA. 48 pp.

Faber, P.M., E. Keller, A. Sands, and B.M. Massey. 1989. The ecology of riparian habitats of the southern California coastal region: a community profile. U.S. Fish and Wildlife Service. Washington, D.C. Biological Report 85(7.27). 152 pp.

Ffolliott, P.F. and D.B. Throud. 1975. Water yield improvement by vegetation management: focus on Arizona. U.S. Forest Service Rocky Mountain Forest and Range Experiment Station, Ft. Collins, CO.

Fraser, D.F., D.A. DiMattia, and J.D. Duncan. 1987. Living among predators: The response of a stream minnow to the hazard of predation. Pp. 121-127 In: Community and evolutionary ecology of North American stream fishes. Matthews, W.J. and D.C. Heins, Eds. University of Oklahoma Press, Norman, OK.

Fyfe, R.W. and R.R. Olendorff. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. Occasional Paper No. 23, Department of the Environment, Canadian Wildlife Service, Anchorage, Alaska.

Garrison, B.A., and J.A. Spencer. 1996. Arizona peregrine falcon 1995 reproductive survey results. Technical Report. Nongame Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona. 43 pp.

Gebhardt, K.A., C. Bohn, S. Jensen, and W.S. Platts. 1989. Use of hydrology in riparian classification. Pp. 53-60 In: Practical approaches to riparian resource management. An educational workshop. May 8-11, 1989. Billings, Mont. Gresswell, R.E., B.A. Barton, and J.L. Kershner, Eds. U.S. Bureau of Land Management, Billings, Mont.

Gill, F.B. 1990. Ornithology. W.H. Freeman and Company, New York, New York. 660 pp.

Gordon, N.D., T.A. McMahon, B.L. Finlayson. 1992. Stream hydrology. An introduction for ecologists. John Wiley and Sons. Chichester, England. 526 pp.

Gorski, L.J. 1969. Traill's Flycatchers of the "fitz-bew" songform wintering in Panama. The Auk 86:745-747.

Green, D.M. and J.B. Kauffman. 1989. Nutrient cycling at the land-water interface: the importance of the riparian zone. Pp. 61-68 In: Practical approaches to riparian resource management. An educational workshop. May 8-11, 1989. Billings, Mont. Gresswell, R.E., B.A. Barton, and J.L. Kershner, Eds. U.S. Bureau of Land Management, Billings, Mont.

Griffith, J.T. and J.C. Griffith. 1994. 1994 brown-headed cowbird removal program on Marine Corps Base Camp Pendleton, California. Final Report October 18, 1994, P.O. NO. M00-681-M4840. Griffith Wildlife Biology, Calumet, Michigan.

Grinnell, J. and A.H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna 27.

Grubb, T.G. and C.E. Kennedy. 1982. Bald eagle winter habitat on southwestern National Forests. USDA Forest Service Rocky Mountain Forest and Range Experiment Station, Research Paper RM-217. 13 pp.

Harrison, H.H. 1979. A field guide to western birds' nests of 520 species found breeding in the United States west of the Mississippi River. Houghton Mifflin Company, Boston, Massachusetts. 279 pp.

Hastings, J.R. 1959. Vegetation change and arroyo cutting in southeastern Arizona. University of Arizona, Arid Lands Program Paper No. 3, Tucson, AZ. 60-67 pp.

Hastings, J.R. and R.M. Turner. 1980. The changing mile. University of Arizona Press, Tucson, AZ. 327 pp.

Haugh, J.R. 1982. Responses of raptors to exploration and construction activities in the National Petroleum Reserve in Alaska. Pages 244-252 In: W.N. Ladd and P.F. Schempf, eds. Proc. Symp. and workshop on raptor management and biology in Alaska and western Canada. PROC-82. USDI, Fish and Wildlife Service, Boise, Idaho. 77 pp.

Hays, L.L. and T.J. Tibbitts. 1989. Distribution of peregrine falcons in Zion National Park. Park Science 9(2):3-4.

Heede, B.R. 1980. Stream dynamics: an overview for land managers. USFS Rocky Mtn. Forest & Range Exp. Station, General Tech. Rept RM 72, Tempe, Az. 26 pp.

Heede, B.R. 1985. Interactions between streamside vegetation and stream dynamics. Pp. 54-57 In: Riparian ecosystems and their management: reconciling conflicting uses. First North American riparian conference. April 16-18, 1985, Tucson, AZ. Johnson, R.R., C.D. Ziebell, D.R. Patton, P.F. Ffolliott, and R.H. Hamre, Eds. U.S. Forest Service Rocky Mountain Forest and Range Experiment Station General Technical Report RM-120, Ft. Collins, CO.

Hendrickson, D.A. 1987. Memo - update on nongame fish activities, August 26, 1987. Arizona Game and Fish Department, Phoenix, AZ. 3 pp.

Hendrickson, D.A. 1993. Evaluation of the razorback sucker (Xyrauchen texanus) and Colorado squawfish (Ptychocheilus lucius) reintroduction programs in central Arizona based surveys of fish populations in the Salt and Verde Rivers from 1986 to 1990. Arizona Game and Fish Department, Phoenix, AZ. 166 pp.

Holmegren, M.A. and P.W. Collins. 1995. Distribution, breeding status, and habitat associations of seven federal special-status bird species and brown-headed cowbirds at Vandenberg Air Force Base, Santa Barbara County, CA. Environmental Report No. 3. Museum of Systematics and Ecology, Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara.

Howell, S.N.G. and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York, New York. 851 pp.

Hubbard, J.P. 1987. The status of the willow flycatcher in New Mexico. Endangered Species Program, New Mexico Department of Game and Fish, Sante Fe, New Mexico. 29 pp.

Hull, T. and D. Parker. 1995. The Gila Valley revisited: 1995 survey results of willow flycatchers found along the Gila River near Gila and Cliff, Grant County, New Mexico. Prepared by Applied Ecosystem Management, Inc. for the Phelps Dodge Corporation. 25 pp.

Hunt, W.G., E.D. Driscoll, E.W. Bianchi, and R.E. Jackson. 1992. Ecology of bald eagles in Arizona. Part A: population overview. Report to U.S. Bureau of Reclamation. Contract 6-CS-30-04470. BioSystems Analysis, Inc., Santa Cruz, CA.

J.M.Montgomery Consulting Engineers, Inc. 1985. Wildlife and fishery studies, upper Gila water supply project. U.S. Bureau of Reclamation, Boulder City, NV. 127 pp.

Johnson, T.H. 1988. Responses of breeding peregrine falcons to human stimuli. Pages 301-305 In: R.L. Glinski *et al.*; eds., Proceedings of the Southwest Raptor Management Symposium and Workshop. National Wildlife Federation, Washington, D.C.

Johnson, T.H. 1994. Peregrine falcon habitat management in National Forests of New Mexico. Unpublished Report. 22 pp.

King, J.R. 1955. Notes on the life history of Traill's flycatcher (Empidonax traillii) in southeastern Washington. The Auk 72:148-173.

Kirsch, P.H. 1888. Notes on a collection of fishes obtained in the Gila River at Fort Thomas, Arizona, by Lieut. W.L. Carpenter, U.S. Army. Proceedings of the U. S. National Museum XI:555-558.

Kondolf, G.M. 1994. Geomorphic and environmental effects of instream gravel mining. Landscape and Urban Planning 28:225-243.

Kus, J. 1995. The status of the least Bell's vireo and southwestern willow flycatcher at Camp Pendleton, California, in 1995. Department of Biology, San Diego State University, San Diego, California.

Langhorst, D.R. and P.C. Marsh. 1986. Early life history of razorback sucker in Lake Mohave. U.S. Bureau of Reclamation, Boulder City, NV. 24 + figs pp.

Leopold, A. 1921. A plea for recognition of artificial works in forest erosion control policy. Journal of Forestry 19:267-273.

Leopold, A. 1924a. Grass, brush, timber, and fire in southern Arizona. Journal of Forestry 22(6):1-10.

Leopold, A. 1924b. Pioneers and gullies. Sunset Magazine May 1924.

Leopold, A. 1946. Erosion as a menace to the social and economic future of the Southwest. A paper read to the New Mexico Association for Science, 1922. Journal of Forestry 44:627-633.

Leopold, L. 1994. A view of the river. Harvard University Press. Cambridge, Mass. 298 pp.

Leopold, L.B., M.G. Wolman, and J.P. Miller. 1964. Fluvial processes in geomorphology. Dover Publications, Inc., New York, NY. 522 pp.

Li, H.W., G.A. Lamberti, R.N. Pearsons, C.K. Tait, J.L. Li, and J.C. Buckhouse. 1994. Cumulative effects of riparian disturbances along high desert trout streams of the John Day Basin, Oregon. Transactions of the American Fisheries Society 123:627-640.

Ligon, J.S. 1961. New Mexico birds and where to find them. The University of New Mexico Press, Albuquerque, New Mexico.

Lowrance, R., R. Todd, J. Fail, Jr., O. Hendrickson, Jr., R. Leonard, and L. Asmussen. 1984. Riparian forests as nutrient filters in agricultural watersheds. BioScience 34(6):374-377.

Mahoney, D.L. and D.C. Erman. 1981. The role of streamside bufferstrips in the ecology of aquatic biota. California Riparian Systems Conference, Sept. 17-19, 1981

Marsh, P.C., F.J. Abarca, M.E. Douglas, and W.L. Minckley. 1989. Spikedace (Meda fulgida) and loach minnow (Tiaroga cobitis) relative to introduced red shiner (Cyprinella lutrensis). Arizona Game and Fish Department, Phoenix, AZ. 116 pp.

Marsh, P.C. and J.E. Brooks. 1989. Predation by ictalurid catfishes as a deterrent to re-establishment of hatchery-reared razorback suckers. The Southwestern Naturalist 34(2):188-195.

Marsh, P.C., J.E. Brooks, D.A. Hendrickson, and W.L. Minckley. 1990. Fishes of Eagle Creek, Arizona, with records for threatened spikedace and loach minnow (Cyprinidae). Journal of the Arizona-Nevada Academy of Science 23(2):107-116.

Martell, M. 1992. Bald eagle management guidelines. The Raptor Center. Univ. of Minnesota, St. Paul, MN.

Mayfield, H. 1977. Brown-headed cowbird: agent of extermination? American Birds 31:107-113.

Maynard, W.R. 1995. Summary of 1994 survey efforts in New Mexico for southwestern willow flycatcher (Empidonax traillii extimus). Contract # 94-516-69. New Mexico Department of Game and Fish, Sante Fe, New Mexico. 48 pp.

McCabe, R.A. 1991. The little green bird: ecology of the willow flycatcher. Palmer Publications, Inc., Amherst, Wisconsin. 171 pp.

McCarthy, M.S. 1987. Age estimation for razorback sucker (Pisces: Catostomidae) from Lake Mohave, Arizona and Nevada. Journal of the Arizona-Nevada Academy of Science 21:87-97.

McDonald, K.P., J. Snider, L.C. Peterson, M. St. Germain, and S. Staats. 1995. Results of 1995 southwestern willow flycatcher surveys in the Virgin River drainage and southern Utah. Publication No. 95-17, Utah Division of Wildlife Resources, Cedar City, UT. 28 pp.

McGeen, D.S. 1972. Cowbird-host relationships. The Auk 89:360-380.

Meehan, W.R. 1991. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19, Bethesda, Maryland. 751 pp.

Meffe, G.K. 1984. Effects of abiotic disturbance on coexistence of predator-prey fish species. Ecology 65(5):1525-1534.

Megahan, W.F., J.P. Potyondy, and K.A. Seyedbagheri. 1992. Best management practices and cumulative effects from sedimentation in the South Fork Salmon River: an Idaho case study. Pp. 401-414 In: Watershed Management. Naiman, R.J., Ed. Springer-Verlag, New York, NY.

Miller, R.R. 1961. Man and the changing fish fauna of the American southwest. Papers of the Michigan Academy of Science, Arts, and Letters XLVI:365-404.

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ. 293 pp.

Minckley, W.L. 1983. Status of the razorback sucker, Xyrauchen texanus (Abbott), in the lower Colorado River basin. The Southwestern Naturalist 28(2):165-187.

Minckley, W.L., P.C. Marsh, J.E. Brooks, J.E. Johnson, and B.L. Jensen. 1991. Management toward recovery of the razorback sucker. Pp. 303-357 In: Battle against extinction; Native fish management in the American west. Minckley, W.L. and J.E. Deacon, Eds. University of Arizona Press, Tucson, AZ.

Minckley, W.L. and J.N. Rinne. 1985. Large woody debris in hot-desert streams: an historical review. Desert Plants 7(3):142-153.

Minckley, W.L. and J.N. Rinne. 1991. Native fishes of arid lands: a dwindling resource of the desert southwest. USFS Rocky Mtn. Forest and Range Exp. Station, General Tech. Rpt. RM-206, Ft. Collins, CO. 45 pp.

Monk, J.G. 1980. Peregrine falcon inventory - data evaluation and management recommendations. USDI, Bureau of Land Management., Ukiah, California. 34 pp.

Muiznieks, B.D., T.E. Corman, S.J. Sferra, M.K. Sogge, and T.J. Tibbitts. 1994. Arizona Partners In Flight 1993 southwestern willow flycatcher survey. Technical Report 52. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program, Phoenix, Arizona. 25 pp.

Murphy, M.L., C.P. Hawkins, and N.H. Anderson. 1981. Effects of canopy modification and accumulated sediments on stream communities. Transactions of the American Fisheries Society 110(4):469-478.

Naiman, R.J. 1992. Watershed management. Springer-Verlag, New York, NY. 542 pp.

New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico., Sante Fe, New Mexico.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16(4):693-727.

Newcombe, C.P. and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. North American Journal of Fisheries Management 11:72-82.

Newton, I. 1979. Population ecology of raptors. Poyser Ltd., Hertfordshire, England. 399 pp.

Oldfield, R.H. 1996. Geology and geomorphological assessment of gravel sites within the Blue River watershed. U.S. Forest Service. Phoenix, AZ. 18 pp.

Olmstead, F.H. 1919. A report on flood control of the Gila River in Graham County, Arizona. U.S. Congress. Sixty-fifth - third session. Senate Document 436., Washington, D.C.. 94 pp.

Olsen, P., and J. Olsen. 1978. Alleviating the impact of human disturbance in the breeding peregrine falcon.

Osborne, L.L. and D.A. Kovacic. 1993. Riparian vegetated buffer strips in water-quality restoration and stream management. Freshwater Biology 29:243-258.

Papoulias, D., D. Valenciano, and D.A. Hendrickson. 1989. A fish and riparian survey of the Clifton Ranger District. Arizona Game and Fish Department, Phoenix, Az. 165 pp.

Patten, D.T. 1989. Effects of phased highway improvements, browsing and moisture stress on the riparian ecosystem along the upper Gallatin River, Montana. Pp. 185 In: Practical approaches to riparian resource management. An educational workshop. May 8-11, 1989. Billings, Mont. Gresswell, R.E., B.A. Barton, and J.L. Kershner, Eds. U.S. Bureau of Land Management, Billings, Mont..

Paxton, E., J.Owen, and M.K. Sogge. 1996. Southwestern willow flycatcher response to catastrophic habitat loss. Colorado Plateau Research Station, U.S. Geological Survey Biological Resources Division Northern Arizona University. 12 pp.

Peterson, R.T. 1990. A field guide to western birds. 3rd ed. Houghton Mifflin Company, Boston, Massachusetts. 432 pp.

Peterson, R.T. and E. Chalif. 1973. A field guide to Mexican birds. Houghton Mifflin Company, Boston, Massachusetts. 432 pp.

Petterson, J.R. and M.K. Sogge. 1996. Distribution and breeding productivity of the southwestern willow flycatcher along the Colorado River in Grand Canyon - 1996. Summary Report. Grand Canyon National Park, Grand Canyon, AZ and National Biological Service Colorado Plateau Research Station/Northern Arizona University. 30 pp.

Phillips, A.R. 1948. Geographic variation in Empidonax traillii. The Auk 65:507-514.

Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson, Arizona. 212 pp.

Platt, J.B. 1977. The breeding behavior of wild and captive gyrfalcons in relation to the environment and human disturbances. Ph.D. Thesis, Cornell University, Ithica, New York. 164 pp.

Porter, R.D., C.M. White, and R.J. Erwin. 1973. The peregrine falcon in Utah, emphasizing ecology and competition with the prairie falcon. Brigham Young University, Bulletin of Biological Science. 18:1-74.

Postovit, H.R. and B.C. Postovit. 1987. Impacts and mitigation techniques. Pages 183-213 In: B.A. Giron Pendleton, B.A. Mildsap, K.W. Cline, and D.M. Bird, eds. Raptor management techniques manual. Scientific Technical Series 10. National Wildlife Federation, Washington, D.C.

Propst, D.L. and K.R. Bestgen. 1991. Habitat and biology of the loach minnow, Tiaroga cobitis, in New Mexico. Copeia 1991(1):29-38.

Propst, D.L., K.R. Bestgen, and C.W. Painter. 1988. Distribution, status, biology, and conservation of the loach minnow (Tiaroga cobitis) Girard in New Mexico. U.S. Fish and Wildlife Service Endangered Species Report 17, Albuquerque, NM. 75 pp.

Propst, D.L., P.C. Marsh, and W.L. Minckley. 1985. Arizona survey for spikedace (Meda fulgida) and loach minnow (Tiaroga cobitis): Fort Apache and San Carlos Apache Indian Reservations and Eagle Creek, 1985. U.S. Fish and Wildlife Service, Albuquerque, NM. 8 + maps pp.

Propst, D.A., J.A. Stefferud, and P.R. Turner. 1992. Conservation and status of Gila trout, Oncorhynchus gilae. The Southwestern Naturalist 37(2):117-125.

Pruett-Jones, S.G., C.M. White, and W.R. Devine. 1980. Breeding of the peregrine falcon in Victoria, Australia. Emu 80:253-269.

Pulliam, H.R. 1988. Sources, sinks, and population regulation. American Naturalist 132:652-661.

Ratcliffe, D.A. 1980. The peregrine falcon. Poyser Ltd., Hertfordshire, England. 416 pp.

Ridgely, R.S. and G. Tudor. 1994. The birds of South America: Suboscine Passerines. University of Texas Press, Austin, Texas.

Rinne, J.N. 1989. Physical habitat use by loach minnow, Tiaroga cobitis (Pisces: Cyprinidae), in southwestern desert streams. The Southwestern Naturalist 34(1):109-117.

Ritchie, R.J. 1987. Response of adult peregrine falcons to experimental and other disturbances along the trans-Alaska Pipeline System, Sagavanirktok River, Alaska, 1985 and 1986. Alaska Biological Research, Fairbanks, Alaska. 91 pp.

Roalkvem, R. 1985. How effective are hunting peregrines? Raptor Research 19(1):27-29.

Roseneau, D.G., C.E. Tell, and R.W. Nelson, 1981. Protective strategies for falcons and other raptors along the proposed northwest Alaska Pipeline. LGL Alaska Research Assoc., Inc., Fairbanks, Alaska. 238 pp.

San Diego Natural History Museum. 1995. Empidonax traillii extimus in California. The willow flycatcher workshop. San Diego Natural History Museum, San Diego, California.

Sandecki, M. 1989. Aggregate mining in river systems. California Geology April:88-94.

Schreiber, D.C. 1978. Feeding interrelationships of fishes of Aravaipa Creek, Arizona. Arizona State University, Tempe, AZ. 312 pp.

Sferra, S.J., T.E. Corman, C.E. Paradzick, J.W. Rourke, J.A. Spencer, and M.W. Sumner. 1997. Arizona Partners In Flight southwestern willow flycatcher survey: 1993-1996 summary report. Arizona Game and Fish Department Technical Report 113.

Sferra, S.J., R.A. Meyer, and T.E. Corman. 1995. Arizona Partners In Flight 1994 southwestern willow flycatcher survey. Final Technical Report 69. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program, Phoenix, Arizona. 46 pp.

Sheldon, D.L. and D.A. Hendrickson. 1988. Report of the 1988 October Fish Count. Arizona Game and Fish Department, Phoenix, AZ. 26 pp.

Silvey, W. and M.S. Thompson. 1978. The distribution of fishes in selected streams on the Apache-Sitgreaves National Forest. Completion report to USDA Forest Service. Arizona Game and Fish Department, Phoenix, AZ. 49 pp.

Simpson, P.W., J.R. Newman, M.A. Keirn, R.M. Matter, and P.A. Guthrie. 1982. Manual of stream channelization impacts on fish and wildlife. U.S. Fish and Wildlife Service, Biological Services Program. FWS/OBS-82/24

Skaggs, R.W. 1995. Population size, breeding biology, and habitat of willow flycatchers in the Cliff-Gila Valley, New Mexico. New Mexico Department of Game and Fish, Sante Fe, New Mexico. 38 pp.

Sogge, M.K. 1995a. Southwestern willow flycatcher (Empidonax traillii extimus) monitoring at Tuzigoot National Monument. 1995 progress report to the National Park Service. National Biological Service Colorado Plateau Research Station/Northern Arizona University, Flagstaff, Arizona. 20 pp.

Sogge, M.K. 1995b. Southwestern willow flycatcher surveys along the San Juan River, 1994 - 1995. Final report to the Bureau of Land Management, San Juan Resource Area. National Biological Service Colorado Plateau Research Station/Northern Arizona University, Flagstaff, Arizona. 27 pp.

Sogge, M.K. 1995c. Southwestern willow flycatchers in the Grand Canyon. Pages 89-91, *in* E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac eds. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Department of the Interior, National Biological Service, Washington, DC.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbitts. 1997. A southwestern willow flycatcher natural history summary and survey protocol. National Park Service/Colorado Plateau Research Station/Northern Arizona State University Technical Report NRTR-97/12.

Sogge, M.K. and T.J. Tibbitts. 1992. Southwestern willow flycatcher (Empidonax traillii extimus) surveys along the Colorado River in Grand Canyon National Park and Glen Canyon National Recreation Area. National Park Service Cooperative Park Studies Unit/Northern Arizona University, Flagstaff, Arizona. 43 pp.

Sogge, M.K. and T.J. Tibbitts. 1994. Distribution and status of the southwestern willow flycatcher along the Colorado river in the Grand Canyon - 1994. Summary Report. National Biological Survey Colorado Plateau Research Station/Northern Arizona University, Flagstaff, Arizona. 37 pp.

Sogge, M.K., T.J. Tibbitts, and S.J. Sferra. 1993. Status of the southwestern willow flycatcher along the Colorado River between Glen Canyon Dam and Lake Mead - 1993. Summary Report. National Park Service Cooperative Park Studies Unit/Northern Arizona University, U.S. Fish and Wildlife Service, and Arizona Game and Fish Department., Flagstaff, Arizona. 69 pp.

Sogge, M.K., T.J. Tibbitts, C. van Riper III, and T.J. May. 1995. Status of the southwestern willow flycatcher along the Colorado River in Grand Canyon National Park - 1995. Summary Report. National Biological Service Colorado Plateau Research Station/Northern Arizona University. 26 pp.

Spencer, J.A., S.J. Sferra, T.E. Corman, J.W. Rourke, and M.W. Sumner. 1996. Arizona Partners In Flight 1995 southwestern willow flycatcher survey. Technical Report 97, March 1996. Arizona Game and Fish Department, Phoenix, Arizona. 69 pp.

Stefferud, S.E. 1995. Field notes, Blue River near Juan Miller road. May 27-28, 1995. U.S. Fish and Wildlife Service, Phoenix, AZ.

Stiles, F.G. and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Comstock, Ithaca, New York. 364 pp.

Stransky, K. 1995. 1995 field survey by the Colorado Division of Wildlife, southwestern willow flycatcher. Colorado Division of Wildlife, Grand Junction, CO. 21 pp.

Stromberg, J.C. 1993. Fremont cottonwood-Goodding willow riparian forests: a review of their ecology, threats, and recovery potential. Journal of the Arizona-Nevada Academy of Science 26(3):97-110.

Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. 393 pp.

Tait, C.K., J.L. Li, G.A. Lamberti, T.N. Pearsons, and H.W. Li. 1994. Relationships between riparian cover and the community structure of high desert streams. Journal of the North American Benthological Society 13(1):45-56.

Thomas, J.W., C. Maser, and J.E. Rodiek. 1979. Riparian zones in managed rangelands--their importance. Pp. 21-30 In: Proceedings of the forum -- Grazing and riparian/stream ecosystems. November 3-4, 1978. Cope, O.B., Ed. Trout Unlimited, Denver, CO.

Tibbets, C.A. 1992. Allozyme variation in populations of the spikedace Meda fulgida and the loach minnow Tiaroga cobitis. Proceedings of the Desert Fishes Council 24:37.

Tibbitts, T.J. and B. Bibles. 1990. Peregrine falcon survey of the Arizona Strip District (1990). Final report to the Bureau of Land Management and Energy Fuels Nuclear, Inc. Arizona Game and Fish Department, Phoenix, Arizona. Cooperative Agreement #AZ950-CA8-001T3. December 1990. 37 pp.

Tibbitts, T.J., M.K. Sogge, and S.J. Sferra. 1994. A survey protocol for the southwestern willow flycatcher (Empidonax traillii extimus). Technical Report NPS/NAUCPRS/NRTR-94/04. National Park Service Colorado Plateau Research Station, Flagstaff, Arizona. 24 pp.

Tibbitts, T.J. and D.K. Ward. 1990a. Peregrine falcon survey, U.S. Bureau of Land Management; Phoenix, Safford and Yuma Districts. 1990 Final Report to U.S. Bureau of Land Management. Arizona Game and Fish Department, Phoenix, Arizona. Cooperative Agreement #AZ950-CA9-02. October 1990. 20 pp.

Tibbitts, T.J. and D.K. Ward. 1990b. Peregrine falcon survey on National Forests in Arizona. 1990 Final Report to U.S. Forest Service. Arizona Game and Fish Department, Phoenix, Arizona. Cooperative Agreement #12-03-89-035P. December 1990. 46 pp.

Tyus, H.M. and C.A. Karp. 1990. Spawning and movements of razorback sucker, Xyrauchen texanus, in the Green River basin of Colorado and Utah. The Southwestern Naturalist 35(4):427-433.

Unitt, P. 1984. The birds of San Diego County. San Diego Society of Natural History.

Unitt, P. 1987. Empidonax traillii extimus: An endangered subspecies. Western Birds 18:137-162.

U.S. Bureau of Reclamation. 1996. Description and assessment of operations, maintenance, and sensitive species of the lower Colorado River. Final biological assessment prepared for the U.S. Fish and Wildlife Service and Lower Colorado River Multi-Species Habitat Conservation Program. Boulder City, NV.

U.S. Fish and Wildlife Service. 1967. Native fish and wildlife. Endangered species. Federal Register 32(48):4001. March 11, 1967.

U.S. Fish and Wildlife Service. 1982. Bald eagle recovery plan (southwestern population). Albuquerque, NM. 65 pp.

U.S. Fish and Wildlife Service. 1984. American peregrine falcon Rocky Mountain/Southwest population recovery plan. Rocky Mountain/Southwest Peregrine Falcon Recovery Team. 105 pp.

U.S. Fish and Wildlife Service. 1986a. Endangered and threatened wildlife and plants; determination of threatened status for the loach minnow. Federal Register 51 (208):39468-39478. October 28, 1986.

U.S. Fish and Wildlife Service. 1986b. Memorandum from Director to Regional Directors, re: Jeopardy standard under the Endangered Species Act. Washington, D.C. March 6, 1986.

U.S. Fish and Wildlife Service. 1991. Endangered and threatened wildlife and plants; the razorback sucker (Xyrauchen texanus) determined to be an endangered species. Federal Register 56(205):54957-54967. October 23, 1991.

U.S. Fish and Wildlife Service. 1993. Notice of 12-month petition finding/proposal to list Empidonax traillii extimus as an endangered species, and to designate critical habitat. Federal Register 58:39495-39522.

U.S. Fish and Wildlife Service. 1994a. Endangered and threatened wildlife and plants; designation of critical habitat for the threatened loach minnow (Tiaroga cobitis). Federal Register 59(45):10898-10906. March 8, 1994.

U.S. Fish and Wildlife Service. 1994b. Notice of 90-day and 12-month findings on a petition to reclassify spikedace (Meda fulgida) and loach minnow (Tiaroga cobitis) form threatened to endangered. Federal Register 59(131):35303-35304. July 11, 1994.

U.S. Fish and Wildlife Service. 1994c. Endangered and threatened wildlife and plants; determination of critical habitat for the Colorado River endangered fishes: razorback sucker, Colorado squawfish, humpback chub, and bonytail chub. Federal Register 59(45): 13374-13400. March 21, 1994.

U.S. Fish and Wildlife Service. 1995a. Endangered and threatened species; bald eagle reclassification; final rule. Federal Register 50(17):35999-36010. July 12, 1995.

U.S. Fish and Wildlife Service. 1995b. Final rule determining endangered status for the southwestern willow flycatcher. Federal Register 60:10694-10715.

U.S.Forest Service, 1977. Importance, preservation, and management of riparian habitat: a symposium, Tucson, Arizona, July 9, 1977. US Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report, Ft. Collins, CO. 217 pp.

U.S. Geological Survey. 1978. Water resources data, Arizona, water year 1978. Water-data report AZ-78-1. Tucson, AZ.

U.S. Geological Survey. 1991. Water resources data, Arizona, water year 1991. Water-data report AZ-91-1. Tucson, AZ.

U.S. Geological Survey. 1996. Water resources data, Arizona, water year 1996. Water-data report AZ-96-1. Tucson, AZ

Velasco, A.L. 1994. Fish population sampling: Aravaipa Creek, Graham and Pinal Counties, Arizona, 1991-92. Arizona State University, Tempe, AZ. 148 pp.

Vives, S.P. and W.L. Minckley. 1990. Autumn spawning and other reproductive notes on loach minnow, a threatened cyprinid fish of the American southwest. The Southwestern Naturalist 35(4):451-454.

Walkinshaw, L.H. 1966. Summer biology of Traill's flycatcher. Wilson Bulletin 78:31-46.

Ward, L.Z. 1993. Arizona peregrine falcon reproductive survey: 1992 report. Nongame and Endangered Wildlife Program Technical Report. Arizona Game and Fish Department, Phoenix, Arizona. 51 pp.

Ward, L.Z. 1994. 1994 peregrine falcon survey methods. Nongame Branch, Wildlife Management Division. Arizona Game and Fish Department, Phoenix, Arizona. 12 pp.

Ward, L.Z., and M.C. Siemens. 1995. Arizona peregrine falcon 1994 reproductive survey results. Nongame Endangered Wildlife Program Technical Report 59. Arizona Game and Fish Department, Phoenix, Arizona. 45 pp.

Waters, T.F. 1995. Sediment in streams. Sources, biological effects, and control. American Fisheries Society, Monograph 7, Bethesda, MD. 251 pp.

White, C.M., W.B. Emison, and W.M. Bren. 1988. Atypical nesting habitat of the peregrine falcon (Falco peregrinus) in Victoria, Australia. J. Raptor Res. 22:37-43.

White, C.M., and T.L. Thurow. 1985. Reproduction of ferruginous hawks exposed to controlled disturbance. Condor 87:14-22.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to brown-headed cowbird parasitism. Masters Thesis, California State University, Chico, California State University, Chico, California.

Whitfield, M.J. 1993. Brown-headed cowbird control program and monitoring for willow flycatchers, South Fork Kern River, California. Draft report to California Department of Fish and Game, Contract #FG 2285., Weldon, California. 11 pp.

Whitfield, M.J. 1994. A brown-headed cowbird control program and monitoring for the southwestern willow flycatcher, South Fork Kern River, California, 1994. Prepared for the California Department of Fish and Game. Kern River Research Center, Weldon, California. 12 pp.

Whitfield, M.J. and C.M. Strong. 1995. A brown-headed cowbird control program and monitoring for the southwestern willow flycatcher, South Fork Kern River, California. California Department of Fish and Game, Bird and Mammal Conservation Program Report 95-4, Sacramento, California. 17 pp.

Willard, F.C. 1912. A week afield in southern Arizona. The Condor 14:53-63.

Willett, G. 1912. Birds of the Pacific slope of southern California. Pacific Coast Avifauna 7.

Willett, G. 1933. A revised list of the birds of southwestern California. Pacific Coast Avifauna 21.

Williams, J.E., D.B. Bowman, J.E. Brooks, A.A. Echelle, R.J. Edwards, D.A. Hendrickson, and J.J. Landye. 1985. Endangered aquatic ecosystems in North American deserts with a list of vanishing fishes of the region. Journal of the Arizona-Nevada Academy of Science 20(1):1-62.

Wilzback, M.A. 1989. How tight is the linkage between trees and trout? Pp. 255 In: California Riparian Systems Conference, September 22-24, 1988. U.S. Forest Service General Technical Report PWS110, Corvallis, OR.

Wood, D.J., S.G. Fisher, and N.B. Grimm. 1990. Pools in desert streams: limnology and response to disturbance. Journal of the Arizona-Nevada Academy of Science 26(2):171-182.

Woodward-Clyde Consultants. 1980. Gravel removal guidelines for Arctic and Subarctic floodplains. U.S. Fish and Wildlife Service FWS/OBS-80/09. 127 pp.

Young, K.R. 1994. Roads and the environmental degradation of tropical montane forests. Conservation Biology 8(4):972-976.

FIGURE 1 - UPPER BLUE RIVER AND PROJECT AREA

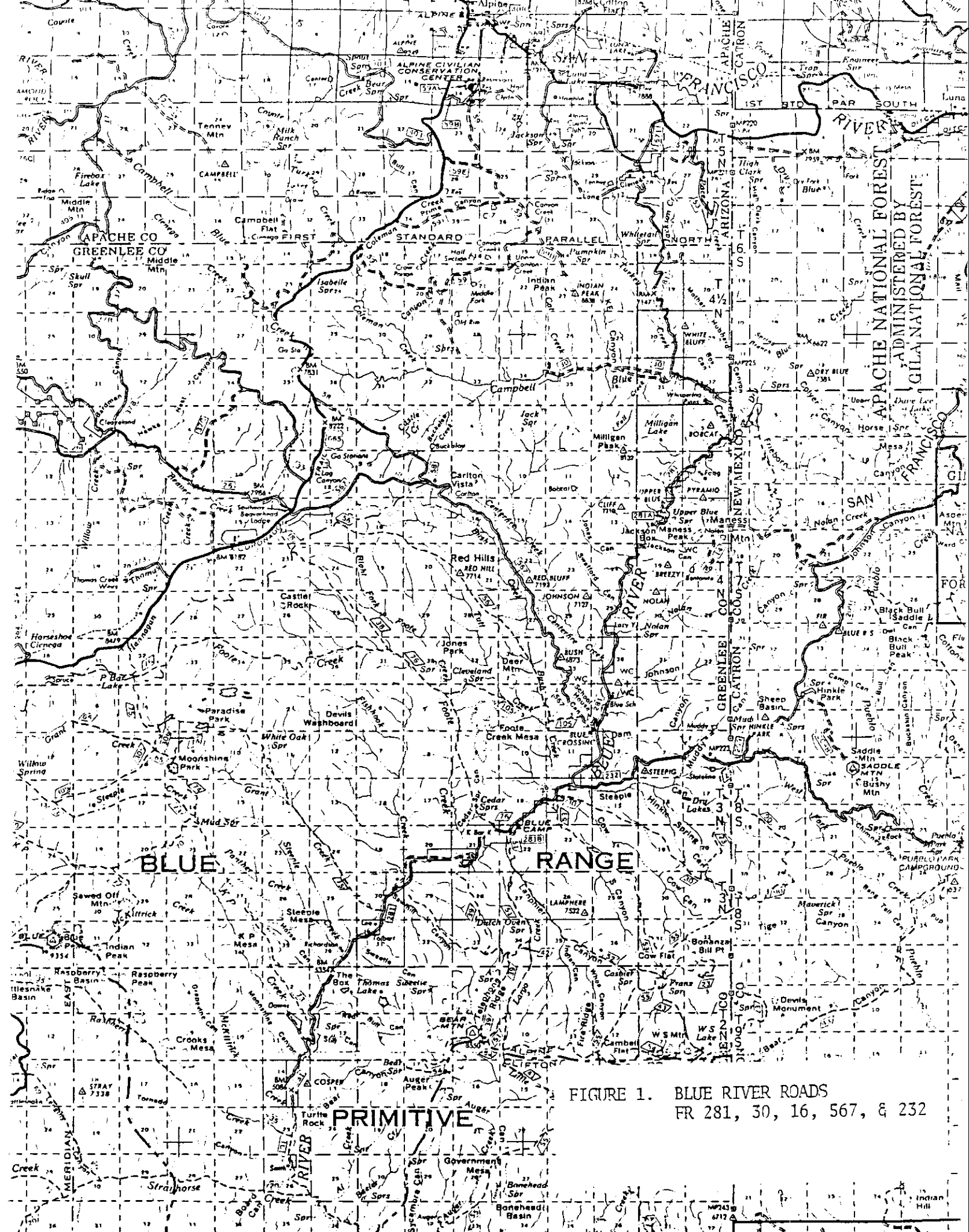

FIGURE 1. BLUE RIVER ROADS
FR 281, 30, 16, 567, & 232

APPENDIX 1 - BEST MANAGEMENT PRACTICES

6/12/97

BEST MANAGEMENT PRACTICES FOR THE MAINTENANCE AND REPAIR OF THE BLUE RIVER ROAD

Best management practices (BMPs) have been developed to provide a general framework of guidelines and criteria that, when implemented, will reduce adverse effects of actions associated with the maintenance and repair of the Blue River road on the Blue River ecosystem.

This document contains nine action items as described by Greenlee County in their efforts to maintain or reconstruct the Blue River Road. Each action item is followed by at least one BMP as excerpted from Forest Service Handbook 2509.22 (The Soil and Water Conservation Practices Handbook) and other references, as cited. Parts of Chapter 40 of the Handbook are included here as pertaining to the action items (Appendix D), and are required in addition to those practices listed after the action items.

All work will be within the USDA easement (defined as 33ft on each side of the centerline of the road; the easement is on file in Greenlee County and at the Alpine Ranger District office) unless prior approval to work outside the easement is obtained. No cultural sites will be impacted without Forest Service concurrence.

The County and the Forest Service will annually and jointly inspect the roadway and agree to an annual operation and maintenance plan that is prepared by the County. This plan will address construction, reconstruction and maintenance activities and will be site-specific, i.e. where, how, when, and why. The county will also document work accomplished and report this work annually to the Forest Service and the Fish and Wildlife Service. Specifically the report will address: date and duration of work, location of work including borrow and disposal areas, areal extent of work, description of work including methods used, description of changes to road and changes to riparian vegetation and stream channel, and a summary of how work compares with these BMPs. Photo documentation will also be used. The intent of the inspection and operating plan is to evaluate the effectiveness of these BMPs against the various issues and concerns generated by the Endangered Species Act (ESA), the Clean Water Act (CWA), and the National Environmental Policy Act (NEPA). This document is intended to be a "living document" in that amendments or changes may be agreed to by the Forest Service and County as necessary.

To facilitate the identification of work sites, the installation of mileposts is highly recommended. The desired future condition for each major stream crossing is to have a structure (i.e. bridge, cement ford, etc.) that will have negligible effects on the stream. It is also desirable to have each culvert inventoried to determine if it is correctly sized, placed, and maintained.

In addition to these nine action items and their associated BMPs, this document also presents mitigations for the implementation of site-specific and project-specific actions associated with (1) the stabilization of banks which will be implemented using emergency management funds, and (2) the excavation and stockpiling of materials to be used for various road-related actions.

I. ACTION ITEMS

ACTION 1 - Wet crossing maintenance and repair.

A road fords a live stream that has recently flowed at a high level. The road is widened and spread out to lower the water depth. The bottom is smoothed and compacted using "clean" material from either the stream or from outside the stream but within the floodplain. The water depth must be no more than 18 inches for a vehicle to safely traverse the stream. The depth of fill is dependent upon the extent of cutting from the flood. Any stream cut-banks are broken down to allow vehicular entry. Generally, work is completed within the right-of-way; no more than 20 cubic yards of material are moved; work takes no more than 2 hours. Either a motor grader or wheeled tire loader is typically used although a bull dozer may be required when conditions dictate.

BEST MANAGEMENT PRACTICES FOR ACTION 1:

*Section 41.18 SERVICING AND REFUELING OF EQUIPMENT

1. OBJECTIVE: To prevent pollutants such as fuels, lubricants, bitumens, raw sewage, wash water and other harmful materials from being discharged into or near rivers, impoundments, or man-made channels leading thereto.

2. EXPLANATION: During servicing or refueling, pollutants from road construction equipment may enter a watercourse. This threat is minimized by locating service and refueling areas and storage/parking areas out of the floodplain and by using berms around such sites to contain spills. Spill prevention, containment and countermeasures plans are required of the County if the volume of fuel exceeds 660 gallons in a single container or if total storage at a site exceeds 1320 gallons.

3. IMPLEMENTATION: The County will designate, with Forest Service concurrence, the location, size and allowable uses of service and refueling areas. The County will also take action in case of a hazardous substance spill as outlined in the Forest hazardous waste contingency plan (see Appendix A). Equipment found to be leaking fluids will be removed from service until repairs can be made.

*Section 41.21: CONTROLLING IN-CHANNEL EXCAVATION

1. OBJECTIVE: To minimize sedimentation and turbidity resulting from excavation for in-channel structures or reconstruction/maintenance of a live stream crossing so as to comply with state and federal water quality standards.

2. EXPLANATION: Excavation is a common requirement for the installation or maintenance of bridges, culverts, low-water crossings and minor streamside structures such as check dams or riprapping. Spoil material developed in such operations should neither obstruct the streamcourse (including natural floodplains) nor the efficiency of the associated structures. Preventative measures include:

a. Keeping excavated materials out of streamcourses (including ephemeral and intermittent).
b. Removing any materials stacked or stockplied on floodplains prior to high water.
c. Diversion of flowing water around work sites to minimize erosion and downstream sedimentation.
d. Importing fill material for better soil compaction. Original fill may have to be exported to a disposal site.
e. Minimize channel and bank disturbance when maintaining the wet crossing. Remove vegetation only as necessary to meet safety concerns. Stay within the right-of-way.

3. IMPLEMENTATION: The County Engineer will supervise in-channel work in accordance with state and federal standards [(i.e. 33 CFR Chap. II, Sec 323.1 to 323.4)(see Appendix B)]; the Clean Water Act; the National Environmental Policy Act and the Endangered Species Act.

*Section 41.2 STREAMCROSSINGS ON TEMPORARY ROADS (Although "temporary" is used here it is understood that permanent stream crossings are also included in this practice.)

1. OBJECTIVE: To keep temporary roads from unduly degrading water quality, damaging streams, disturbing channels or impeding fish passage; so that state and federal water quality standards are complied with.

2. EXPLANATION: Culverts, coarse rock fills, hardened fords (using such features as rocked approaches), low water crossings and temporary bridges shall be evaluated by the Forest Service and the County on the annual road inspection. Such facilities shall be designed to provide for unobstructed flows and the passage of fish, and to minimize damages to streamcourses. The number of crossings shall be kept to a minimum. Channel crossings shall be as perpendicular to streamcourses as possible. Streambank excavation shall be kept to the minimum needed for use of the crossings, and entry and exit ramps may need to be rocked. Temporary crossing facilities will be removed when the facility is no longer needed.

3. IMPLEMENTATION: On existing crossings, work within the normal road width as much as possible; minimize plant material removal; remove berms and do not place the material in the stream. The desired future condition is to have a concrete ford or bridge at each crossing and provide routine maintenance on the gravel bar as needed.

*Section R-5 2-18: REGULATION OF STREAMSIDE GRAVEL BORROW AREAS

1. OBJECTIVE: To limit channel disturbances and sediment production associated with gravel source development.

2. EXPLANATION: Materials deposited along channel sections during storm runoff often provide an inexpensive source of gravel. Because of easy access this gravel is in demand. With adequate planning, it can often be removed with minimal impact on water resources and channel stability. Under some circumstances gravel removal may alter streamflow characteristics and consequently affect stream channel stability and create a new sediment source.

Do not allow wash water or waste from concrete batching or aggregate operations to enter streams prior to treatment by filtration, flocculation, settling and/or other means.

3. IMPLEMENTATION:

a. **Water Table:** No excavation in or below water table.

b. **Channel Crossing for Access:** No crossing through active channel to access gravel materials on opposite bank. Also no crossing standing shallow back water areas for material access.

c. **Riparian Vegetation:** No removal of riparian vegetation adjacent to the Blue River. Minor removal of a few seedlings in tributary deposits is acceptable but should be minimized.

d. **Road Elevation:** Materials accessed at or near road grade are priority over materials located 6-10 feet below road elevation, and requiring an access ramp to be built. These materials are available, but should receive low priority due to greater costs and ecological impact.

e. **Low Flow Excavation:** During normal annual maintenance operations materials are to be excavated only during low flows, and are to be removed to stockpiling areas, in order to minimize duration of disturbance in material source areas.

f. **Volume Extracted per Site:** During normal annual maintenance operations, materials sites chosen will contain a minimum of 200 cubic yards of material. The purpose of minimum volumes is to reduce over all impact in the number of sites disturbed. Recommended quantity removed from a given site should normally not exceed 1500 cubic yards. The purpose of maximal limits is to reduce the chance of altering channel morphology in any given location. Is is advised that gravel extraction needs to be sensitive to immediately local conditions, and however possible, not to induce channel changes. This is difficult to predict, but can perhaps be aleviated by removing greater depths of material from older and thicker deposits (i.e. 10 year flood plains) and decreasing the depth removed on more recent thinner deposits (i.e. 5 year flodplains). This would not apply to point bars (deposits on inside of river bend), illustrating the point that local conditions must be interpreted correctly.

g. **Number of Sites Disturbed in any Given Year:** Number of sites disturbed in any given year is recommended to 6 sites between and including the confluence of the Campbell Blue River and Turkey Creek on the northern end, to the Blue Box on the south.

h. **Disturbance Interval:** Material source areas are to be disturbed as few times as possible, over the long run. This means available materials need to be removed to a stockpile, and the site left alone until the stockpile is exhausted, and the material removed has been replenished by high flows. This may take one year if a large peak flow occurs, or it may take 5 or more years of lower flows.

i. **Floodplain Interval of Material Source Areas:** Areas considered suitable for materials excavation are to be outside of the normal bank-full stage (defined as the 2.5 year flood stage recurrence interval). No materials are to be removed from the active channel. Maximum elevation of material removal is to be the 10 year floodplain elevation. These areas are usually in the riparian shrub zone (willows and cottonwoods) but large gravel bars are normally devoid of ground cover. No riparian vegetation is to be removed. No "historic floodplains" are to be disturbed. These are normally vegetated with old-growth riparian growth forms of upland species, as well as riparian species.

j. **Emergency Life Safety Protection Measures:** During peak flows of low frequency flood events (i.e. a 100 year flood), often whole sections of road are lost and the road is obviously impassable. In order to re-open the road as soon as possible, primitive temporary paths are usually opened with bull dozers. Since the entire road prism is normally gone, this volume of material must be replaced to re-construct a road bed. Depending on the severity of the situation, the need for material in one location usually exceeds the volume of material needed for annual maintenance on the entire road. For this reason, fill is usually dozed from a nearby gravel bar to replace the road prism. In these situations, it is advised that the County contact the Forest Service in order to jointly assess the best solution to the site specific problem.

<u>ACTION 2</u> - Dry crossing maintenance and repair

A road crossing cuts through a dry stream. Material within or adjacent to the crossing is moved and compacted to form the road. Additionally, if needed, road surfacing material is placed and smoothed and cut banks are broken down to allow vehicular entry. Generally, no more than 10 cubic yards of material are moved and work takes no more than 1 hour. A motor grader or wheeled tire loader is used although a bull dozer may be used when conditions dictate. Work is completed within the right-of-way.

BEST MANAGEMENT PRACTICES FOR ACTION 2:

*Section 41.2: **STREAMCROSSINGS ON TEMPORARY ROADS** (see above)

*Section 41.17: **CONTROL OF SIDECAST MATERIAL**

1. OBJECTIVE: To minimize sediment production from sidecast material during road construction, reconstruction or maintenance.

2. EXPLANATION: Unconsolidated sidecast material can be difficult to stabilize and is susceptible to erosion and/or mass instability. Loose, unconsolidated sidecast material should not be permitted to enter streamside management areas. Sidecasting is not an acceptable construction alternative in areas where it will adversely affect water quality. Prior to commencing construction or maintenance activities, waste areas should be located where excess material can be deposited and stabilized.

3. IMPLEMENTATION: Sidecast material less than 2 inches in size shall be used again as road surfacing; material in excess of 2 inches will be used to armor drainages within the right-of-way, placed in areas needing such material (i.e. access roads) or deposited in waste areas. All waste areas will be mutually selected by the County and Forest Service.

*Section 41.25: MAINTENANCE OF ROADS

1. OBJECTIVE: To maintain roads in a manner which provides for water quality protection by minimizing rutting, failures, sidecasting and blockage of drainage facilities (all of which can cause sedimentation and erosion).

2. EXPLANATION: Roads normally deteriorate because of use and weather impacts that are not corrected with maintenance. This deterioration can be minimized through adequate maintenance and/or restriction of use (ie. Red Hill road). The goal is to maintain the road so as to protect the investment and to see that damage to adjacent land and resources is held to a minimum. Maintenance scheduling requires an annual inspection to determine what work, if any, is needed to keep drainage functional and the road stable. Higher levels of maintenace may be chosen to reflect greater use or administrative needs. Additional maintenance measures could include resurfacing, outsloping, clearing debris from dips and cross drains, armoring of ditches and spot rocking.

3. IMPLEMENTATION: The work is controlled by the County Engineer who develops a road maintenance plan. Consider installing an erosion control structure upstream and downstream of each culvert or low-water crossing to allow the structure to clean itself of debris (Forest Service will concur with the design); remove berms from the side of the road where appropriate to allow water to run off the side of the road. All bladed material over 2 inches will be used to help armor drainage structures and not left by the side of the road. Ditches adjacent to the roadway will be allowed to revegetate so as to reduce the sediment load of water entering culverts. As culverts are replaced, they shall be sized appropriately and structures such as energy dissipators and trash racks will be considered. Leadout ditches will drain into a vegetated buffer area.

ACTION 3 - Protection of structures at stream crossings

A structure (pipe and concrete box culverts and bridges) spans either a wet crossing or a dry stream crossing. The structure, abutements, stream approach and departure and structure bottom may be worked to protect the structure. The work may include smoothing, dredging, filling, widening, or narrowing the stream channel. Generally work is completed within the right-of-way. Work on the stream approach and departure may require actions outside the road right-of-way. The work duration and equipment used will depend upon the extent of damage.

BEST MANAGEMENT PRACTICES FOR ACTION 3:

*Section 41.17: CONTROL OF SIDECAST MATERIAL (see above)

*Section 41.21: CONTROLLING IN-CHANNEL EXCAVATION (see above)

If bypass roads are needed to allow work on the bridge or culvert then they will be suitably located with plans for their subsequent obliteration and stabilization.
Culverts will be installed during minimum flows.

*Section 41.15: TIMELY EROSION CONTROL MEASURES ON INCOMPLETE ROADS AND STREAMCROSSING PROJECTS

1. OBJECTIVE: To minimize erosion and sedimentation from road construction sites where final drainage structures have not been completed.

2. EXPLANATION: The best drainage design can be useless if projects are incomplete at the end of the normal operating season. Affected areas can include roads, fills, streamcrossings and bridge excavations. Preventative measures include:

a. The removal of water-controlling devices that will not carry anticipated seasonal water runoffs such as temporary culverts or diversion dams.
b. The installation of temporary devices that will carry anticipated seasonal water runoff such as culverts, diversion ditches or other facilities needed to control erosion.
c. The removal of debris, obstructions and spoil material from channels and floodplains.
d. Planting native vegetation and/or mulching.

3. IMPLEMENTATION: Apply protective measures to all areas of disturbed, erosion-prone, unprotected ground that is not to be further disturbed in the present operating period.

ACTION 4 - Road resurfacing

Resurfacing is required to replace road material eroded by flood water or regular use. Flood water overtopping of roads will remove road surface materials and regular road use will push gravel into base or will throw or carry material off the road. This material needs to be replaced for safety and ride quality. A wheel tire loader to load haul trucks and a grader and compactor to spread material will be required. The work duration is dependent upon the length of road to be surfaced.

BEST MANAGEMENT PRACTICES FOR ACTION 4:

*Section 41.21: CONTROLLING IN-CHANNEL EXCAVATION (see above)

*Section R-5 2-18: REGULATION OF STREAMSIDE GRAVEL BORROW AREAS (see above)

*Section 41.25: MAINTENANCE OF ROADS (see above)

ACTION 5 - Slide removal and stabilization

A slide is a failure of a bank or a hill above a road causing debris to be deposited upon a road. The resulting debris is either pushed over the side of the road or is loaded and moved. Unstable and erodible areas should be stabilized by use of seeding, compacting, rip-rapping, benching, mulching or other suitable means. Blasting may be required to effect repairs. The work duration and equipment to be used depend upon the extent of damage.

BEST MANAGEMENT PRACTICES FOR ACTION 5:

*Section 41.17: CONTROL OF SIDECAST MATERIAL (see above)

Slide material already within the stream will not be removed nor will slide material be pushed into a floodplain. Any rip-rapping will be done per Section 4.23 below.

ACTION 6 - Excavation of materials for road repair and maintenance

Material gathering is the excavation of material to be used to repair or resurface roads from either the road banks or the floodplain of an adjacent stream. Material for road repair is cut from banks along the roadway or material is gathered from adjacent floodplain of a perennial stream or bed of an ephemeral stream. Materials will not be excavated from areas having water. Sites should be left smooth and free of evidence of heavy equipment operations. The work duration depends upon the extent of damage. Equipment could include a bull dozer and wheel tire loader.

BEST MANAGEMENT PRACTICES FOR ACTION 6:

*Section R-5 2-18: REGULATION OF STREAMSIDE GRAVEL BORROW AREAS (see above)

ACTION 7 - Repair of under-cut road

Under-cutting is the encroachment of a stream on a road eroding the bank. The road can be moved within the right-of-way easement or the road can be restored by replacing the eroded materials and protecting with riprap or other similar means. Often the cause of this condition is a change in the stream channel. As a last resort, it may be necessary to move the stream to its pre-event location by channelization to complete necessary repairs. The work durations depend upon the extent of damage. Equipment could include a bull dozer and wheel tire loader.

BEST MANAGEMENT PRACTICES FOR ACTION 7:

*Section 41.17: CONTROL OF SIDECAST MATERIAL (see above)

*Section 41.19: DIVERSION OF FLOWS AROUND CONSTRUCTION SITES

1. OBJECTIVE: To ensure that all stream diversions are carefully planned; to comply with state and federal water quality standards; to restore stream channels to their natural grade, condition and alignment.

2. EXPLANATION: Flow must sometimes be guided or piped around project sites. Typical examples are bridge and road construction. Flow in streamcourses will be diverted, if necessary, to protect water and related resources during the project. Such a diverted flow shall be restored to the natural streamcourse as soon as practicable only if the Forest Service concurs.

3. IMPLEMENTATION: Where and when diversions are required will be determined by the County Engineer and approved by the Forest Service. The diversion will be kept to the minimum length possible.

*Section 41.21: CONTOLLING IN-CHANNEL EXCAVATION (see above)

*Section R5 2-18: REGULATION OF STREAMSIDE GRAVEL AREAS (see above)

*Section 41.23 SPECIFYING RIPRAP COMPOSITION

1. OBJECTIVE: To minimize sediment production associated with the installation and utilization of riprap material in compliance with state and federal water quality standards.

2. EXPLANATION: Riprap is commonly used to armor streambanks and drainage ways from the erosive forces of flowing water. Riprap must be sized and installed in such a way that it effectively resists erosive water velocities. On occasion this may require the use of filter blankets or other methods to prevent the undermining of fines. Stone used for riprap should be free from weakly structured rock, soil, organic material and materials of insufficient size; all of which are not resistant to streamflow and would only serve as sediment sources.

3. IMPLEMENTATION: Rip-rap will be installed during low water season preserving as much vegetation as possible. Where possible, placement of rock will be accomplished using equipment capable of staying on the road surface and placing the rock in the correct location.

<u>ACTION 8</u> - River channelization

River channelization is removing debris from and causing water to flow in a pre-event channel. This action may be necessary to move water to effect bank erosion repair or structure stabilization. Dikes of river-run materials, often existing before the event, may be repaired or constructed to cause water to reenter the pre-event channel. Generally, work is completed on the pre-event channel before water is allowed to return. The work duration depends upon the extent of the damage. Equipment could include a bull dozer and wheel tire loader.

BEST MANAGEMENT PRACTICES FOR ACTION 8:

*Section 41.19: DIVERSION OF FLOWS AROUND CONSTRUCTION SITES (see above)

The portion of the road north of the primitive area boundary may include the possibility of re-routing the road. The placement of road protection structures such as rip-rap should be done during low-water seasons to reduce the need to divert the stream. Dikes or major channeling of the stream will not be done nor existing dikes be maintained.

ACTION 9 - Surface maintenance of road

Maintenance activities occur periodically. They include, but are not limited to; surface maintenance (primarily grading), snow removal, vegetation removal and installation and servicing of traffic and animal control devices including cattle guards, gates, fences, etc. Traffic devices include signs, delineators, guard rails, etc. Vegetation must be kept back from the road edges for site distance and to allow for maintenance activities. Snow and ice accumulations are removed for safety.

Surface maintenance generally is blading or smoothing the road surface but may also include the addition of road materials such as gravel and rock. All of these items are usually completed periodically as needed. A full range of appropriate equipment may be used on regular maintenance activities including motor grader, dump trucks, chain saw, compactor, water truck and wheel tire loader.

BEST MANAGEMENT PRACTICES FOR ACTION 9:

*Refer to Booklet "IDAHO BEST MANAGEMENT PRACTICES" Chapter 5 RE.SEDIMENTATION (Appendix C)

*Section 41.17: CONTROL OF SIDECAST MATERIAL (see above)

*Section 41.25: MAINTENANCE OF ROADS (see above)

*Section 41.14: CONTROL OF ROAD DRAINAGE

1. OBJECTIVE: To minimize the erosive effects of concentrated water flows caused by road drainage features; to disperse runoff from disturbances within the road clearing limits; to lessen the sediment load from roaded areas; to minimize erosion of the road prism by runoff from road surfaces and from uphill areas.

2. EXPLANATION: A number of measures can be used (alone or in combination) to control road drainage. Methods used to reduce erosion may include such things as properly placed culverts, cross drains, water bars, dips, energy dissipators, aprons, downspouts, gabions, and/or debris racks and armoring of ditches and drain inlets and outlets.

Dispersal of runoff can be accomplished by such means as rolling the grade, insloping, outsloping, crowning, installation of water spreading ditches, contour trenching or overside drains. Dispersal of runoff also reduces peak downstream flows and associated high water erosion and sediment transport.
Sediment loads can be reduced by installing such things as sediment filters, settling ponds and contour trenches. Soil stabilization and dispersed water flows on borrow and waste areas, cut and fill slopes and road shoulders can minimize sedimentation.

3. IMPLEMENTATION: The County is responsible to adhere to these practices in accordance with their annual maintenance plan.

II. BANK STABILIZATION USING EMERGENCY MANAGEMENT FUNDS

The State of Arizona has provided emergency management funds to Greenlee County for the repair of embankments along the Blue River road that were impacted during recent floods. The following direction applies specifically to these repairs. All of the "wet sites" proposed for emergency management work at present are less than 400 linear feet in length.

Materials used to stabilize embankments proposed for emergency management projects along the Blue River road will consist of rock over 6 inches in diameter. The intent of Greenlee County is to utilize rocks 2 to 4 feet in diameter to armour and stabilize the embankments to prevent additional erosion of the road bank and to reduce the continued input of sediments into the river. The fracturing of large rocks is likely to occur during their transport to the work sites resulting in some smaller materials. However this smaller material is anticipated and hoped to comprise only a very minor portion of the material. These materials will be obtained from an upland slide area on private land.

At work sites where woody riparian vegetation is present along the existing toe of the embankment, embankment boulders will be individually placed with a track hoe (or similarly functioning equipment) to minimize adverse effects to the riparian vegetation.

III. EXCAVATION AND STOCKPILING OF MATERIALS

One means of reducing sediments generated by the Blue River road, and reducing the need for repeated maintenance actions is surfacing the road with compacted gravels. Presently, much of the Blue River road is surfaced with compacted fines that quickly soften when wetted by rain and snow. When wetted, the road is subject to rutting by vehicles and the fines are prone to moving with the runoff toward the Blue River. Subsequent road maintenance in itself may generate fines that may find their way into the Blue River. By placing a more durable surface on the road, the frequency and extent of routine road maintenance and the contribution of sediments from the road to the Blue River are likely to be significantly reduced.

Additionally, in several places along the Blue River road low points in the road grade create areas where precipitation pools on the road, exacerbating the problems of road maintenance and sediment production. In conjunction with the improvement of the road surface by hardening with gravels, elevating the grade of the road in low areas and installing subgrade culverts would significantly reduce road maintenance needs (caused by vehicular traffic on soft-surfaced, muddy roads), and significantly reduce sediments originating from the road by preventing water collection and runoff from the road grade. It is recognized that road reconstruction is outside the scope of this project at this time. However, by extracting gravels from sites near the Blue River and stockpiling them nearby will greatly facilitate both the continuing road maintenance needs and the future improvement of road grades. In this way, adequate quantities of suitable materials may be made available to Greenlee County to meet immediate needs addressed in this project, and to begin a long-term program to drastically reduce the level of routine road maintenance and the level of sediments originating from the road. In addition, the use of stockpiles will permit the flexibility to extract gravels during the least environmentally sensitive times.

Based on criteria and guidelines identified in the BMPs, several sites have been identified that are suitable for the extraction and stockpiling of gravels. The selection of the following sites also included consideration of information obtained during site visits by Tom Subirge (Riparian Specialist/Soil Scientist, Apache-Sitgreaves National Forests), Robert Oldfield (Mineral Examiner, U. S. Forest Service, South-Central Arizona Zone), Darrell Miller and Bill Marks (Greenlee County), and Terry Myers (Rare Species Coordinator, Apache-Sitgreaves National Forests). In addition, the U. S. Army Corps of Engineers (Ron Fowler) and U. S. Fish and Wildlife Service, Arizona Ecological Services Field Office (Bruce Palmer, Sally Stefferud) suggested ideas and considerations important to the selection of sites and the implementation of both extracting and stockpiling of materials. (Site numbers below correspond to those in Oldfield (1996). Volumes of materials at each site represent rather crude estimates of gravels presently available for excavation. Subsequent replenishment of gravels at these sites may result in stockpiles that contain more volume than indicated as present at the excavation site.)

Normal Excavation Sites	Estimated Volume	Stockpile At Site
1	110yds	Yes
3	2300	Yes
4	900	Yes
6	9000	Yes
12	270	Yes
21	1000	Yes

Emergency Only Sites	Estimated Available Volume	
2	450	No stockpiling
8	700	No stockpiling

Special Status Sites	Estimated Available Volume	Comments
9	750	Excavation and stockpile sites on private land.
13	10	Removal of material associated with maintenance of grade control structure. Stockpile at nearby site (eg. site 12).
16	10	Removal of material associated with creating sediment trap from Swafford Canyon. Stockpile at site.
17	3600	Old berm created for flood control is now available for excavation.
18	380	Removal of material associated with maintenance of wet crossing at Blue Crossing.
20	500	Only materials that can be accessed without crossing the Blue River will be considered.

General locations of these sites are indicated in Appendix E. The Forest Riparian Specialist will participate in the precise delineation of extraction and stockpile sites.

Prior to their use, all stockpile and excavation locations will comply with permitting and procedures as required by the U.S. Forest Service.

Additional sites will likely be proposed by Greenlee County in the future as they are identified or as they become available. Any new site not identified above will require approval by the U. S. Fish and Wildlife Service, U. S. Forest Service and U. S. Army Corps of Engineers to ensure that all necessary regulations, permits, etc. are followed or obtained.

Excavation and stockpile sites will be photographed by Greenlee County prior to, and after the development of those sites.

In addition to following BMPs, extraction will occur no closer than about 60 feet from the river (outside the normal bank-full stage).

All stockpiles will be located so as to minimize the likelihood of being impacted by severe floods. All stockpiles will be located outside the "ordinary high water level" as it applies to Army Corps of Engineers jurisdictional boundaries.

Greenlee County desires to screen materials from all normal excavation sites using a 1 1/2" screen. When screened, stockpiles will consist of two material heaps: one pile with materials <1 1/2", and one pile with materials >1 1/2 ". Materials will not be washed.

The <1 1/2 inch materials will be used to resurface roads. Greenlee County desires to use a vibratory roller following the placement of these materials during normally scheduled resurfacing. Because the roller is typically housed in the Clifton vicinity, the roller may not be available for small, unscheduled, emergency road surfacing.

The >1 1/2 inch materials will be used to construct containment berms around the stockpiles to reduce the likelihood of sediments from the stockpiles being discharged into the river. These materials may also be used to armour ditches, to construct erosion control structures, and in other applications where "clean" materials are required.

Except in emergency situations, no new crossings on the Blue River will be created to extract any gravels or to transport them to stockpiles. (See also BMPs Section R-5 2-18, Implementation item 3).

Emergency conditions may necessitate the use of non-stockpiled materials from sources other than those identified above. Under emergency conditions, gravel extraction will adhere to BMPs identified in Action 1, "Section R-5 2-18: REGULATION OF STREAMSIDE GRAVEL BORROW AREAS and other BMPs as applicable.

APPENDIX D

This section lists soil and water conservation practices that may be applicable for the Blue River road and are found in Chapter 40 of Forest Service Handbook 2509.22.

SECTION 41.11 TIMING OF CONSTRUCTION ACTIVITIES

1. Objective: to comply with state and federal water quality standards.

2. Explanation: Scheduling operations during periods when the probabilities for rain and runoff are low is an essential element of effective erosion control. Equipment shall not be operated when ground conditions are such that unacceptable soil compaction or displacement result.
Erosion control work is kept current. Construction of drainage facilities and performance of other work which will contribute to the control of erosion and sedimentation shall be carried out in conjunction with earthwork operations or as soon thereafter as practicable. The area being graded at a site at any one time should be limited, and the time that an area is without protective cover (for example, vegetation, jute matting, etc) should be minimized.

3. Implementation: Scheduling of operations is performed by the County Engineer.

SECTION 41.12 ROAD SLOPE STABILIZATION

1. Objective: To prevent on-site soil loss from exposed cut slopes, fill slopes, and spoil disposal areas.

2. Explanation: Depending on various factors such as slope angle, soils, climate, and proximity to waterways, fill slopes, cut slopes, and spoil disposal areas will require vegetative and/or mechanical measures to provide soil stability. The level of stabilization effort needed must be determined on a case-by-case basis.

Vegetation measures include the seeding of herbaceous species (grass, legumes, or browse), or the planting of trees. Vegetative measures may include fertilization and mulching to ensure success. Mechanical measures may include erosion nets, terraces, side drains, mats, riprapping, and retaining walls.

3. Implementation: The County Engineer will select the appropriate means of slope stabilization. If vegetative methods are planned, then only native vegetation will be used per Forest Service recommendations. Mechanical and vegetative surface stabilization measures shall be periodically inspected to determine effectiveness. In some cases, additional work may be needed to ensure that the vegetative or mechanical measures are functional.

SECTION 41.13 DISPERSION OF SUBSURFACE DRAINAGE FROM CUT AND FILL SLOPES

1. Objective: To minimize the possibilities of cut or fill slope failure and the subsequent production of sediment.

2. Explanation: Roadways may change the subsurface drainage characteristics of a slope. Since the angle and height of cut and fill slopes increase the risk of instability, it is often necessary to provide subsurface drainage to avoid moisture saturation and subsequent slope failure. Where it is necessary because of slopes, soil, aspect, precipitation amounts, inherent instability or other related characteristics, one of the following dispersion methods should be used: pipe drains, horizontal drains, or stabilization trenches. Dispersal of collected water should be done in an area capable of withstanding increased flows. Energy dissipators may need to be placed below pipes carrying large volumes of water.

3. Implementation: Project location and design will be the responsibility of the County Engineer.

SECTION 41.16 CONSTRUCTION OF STABLE EMBANKMENTS (FILLS)

1. Objective: To construct embankments with materials and methods which minimize the possibility of failure and subsequent water quality degradation.

2. Explanation: The failure of road embankments and the subsequent deposition of material into waterways may result from a lack of compaction during the construction of the embankment, as well as from the use of inappropriate placement methods. To minimize this occurrence, the roadway should be designed and constructed as a stable and durable earthwork structure with adequate strength to support the surfacing, shoulders, and traffic. Proper slope ratio design will promote stable embankments.

3. Implementation: The appropriate method of embankment placement will be selected and supervised by the County Engineer.

SECTION 41.22 DISPOSAL OF RIGHT-OF-WAY AND ROADSIDE DEBRIS

1. Objective: To comply with state and federal water quality standards, ensure that debris generated during road construction is kept out of streams and to prevent slash and debris from subsequently obstructing channels, and to ensure debris dams are not formed which obstruct fish passage or which could result in downstream damage from high water flow surges after dam failure.

2. Explanation: As a preventative measure, construction debris and other newly generated roadside slash developed along roads near streams (in the streamside management zone) shall not be deposited in stream channels (including ephemeral and intermittent). Some disposal methods are: piling and burning, chipping, burying, scattering, removal to approved disposal sites, bucked into manageable lengths and piled alongside the roadway for fuelwood.

3. Implementation: The County Engineer and the Forest Service jointly agree on disposal methods.

SECTION 41.28 SNOW REMOVAL CONTROLS TO AVOID RESOURCE DAMAGE

1. Objective: To minimize the impact of melt water on road surfaces and embankments and to reduce the probability of sediment production resulting from snow removal operations.

2. Explanation: This is a preventative measure used to protect resources and indirectly to protect water quality. The County is responsible for snow removal in a manner which will protect roads and adjacent resources. Snow berms shall be removed or placed to avoid accumulation or channelization of melt water on the road and prevent water concentration.

3. Implementation: The County Engineer is responsible for ensuring proper snow removal techniques are used.

APPENDIX E

Locations and Descriptions of Excavation and Stockpile Sites
(See attached map for locations)

Site	Comments
1	Confluence of Campbell Blue and Turkey Creeks
2	Emergency site only.
3	Confluence of Campbell Blue and Mother Hubbard Creeks
4	Near confluence of Blue and Dry Blue Rivers
6	Wide meadow with gravel bar at river.
8	Emergency only.
9	Likely on private land.
12	Excavation associated with culvert maintenance. Minimize impacts to sapling cottonwoods during site layout.
13	Excavation associated with maintenance of dry crossing of side drainage.
16	Excavation associated with maintenance of dry crossing of side drainage.
17	Berm originally constructed for flodd control, now available for excavation.
18	Excavation associated with maintenance of wet crossing at Blue Crossing.
20	In vicinity of Fishhook Creek confluence with Blue River. Blue River will not be accessed to reach excavation or stockpile sites. Within Blue Primitive Area boundary.
21	Near confluence of Steeple Creek and Blue River. Within Blue Primitive Area boundary.